The American Journal of Surgery

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September 1948

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SUTURES IN ANCIENT SURGERY

Fabricius

(1537-1619)

SUTUREGRAM

NUMBER NINE IN A SERIES

Complications of Suturing

Edges separate because . . .

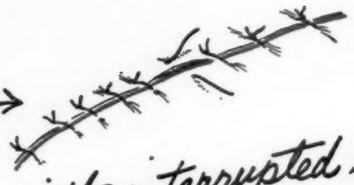
1. Suture cuts through tissue

Result of tight tying
Occurs after 3 or 4 days

2. Knots become untied

Result of failure to tie 3 square knots

3. Knot becomes untied at end of continuous suture



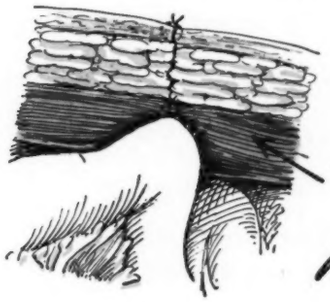
Cannot occur with interrupted sutures
If one knot becomes untied, rest remain tied and carry on intended function

SUTUREGRAM NUMBER NINE (CONTINUED)

Types of Wound Dehiscence

a) Separation of skin edges

b) Post-operative hernia



Anterior sheath remains sutured and heals

Posterior sheath and peritoneum separate

c) Evisceration
All layers separate to the skin.

(To be continued)

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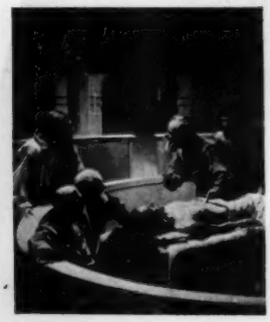

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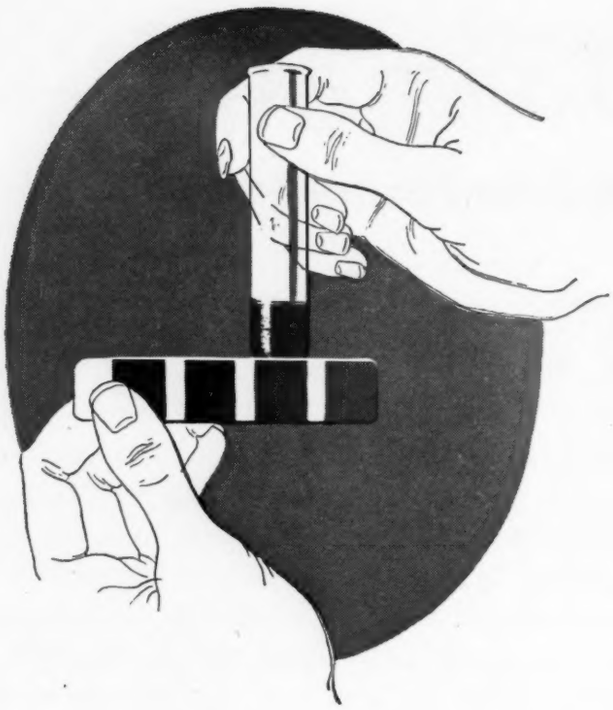

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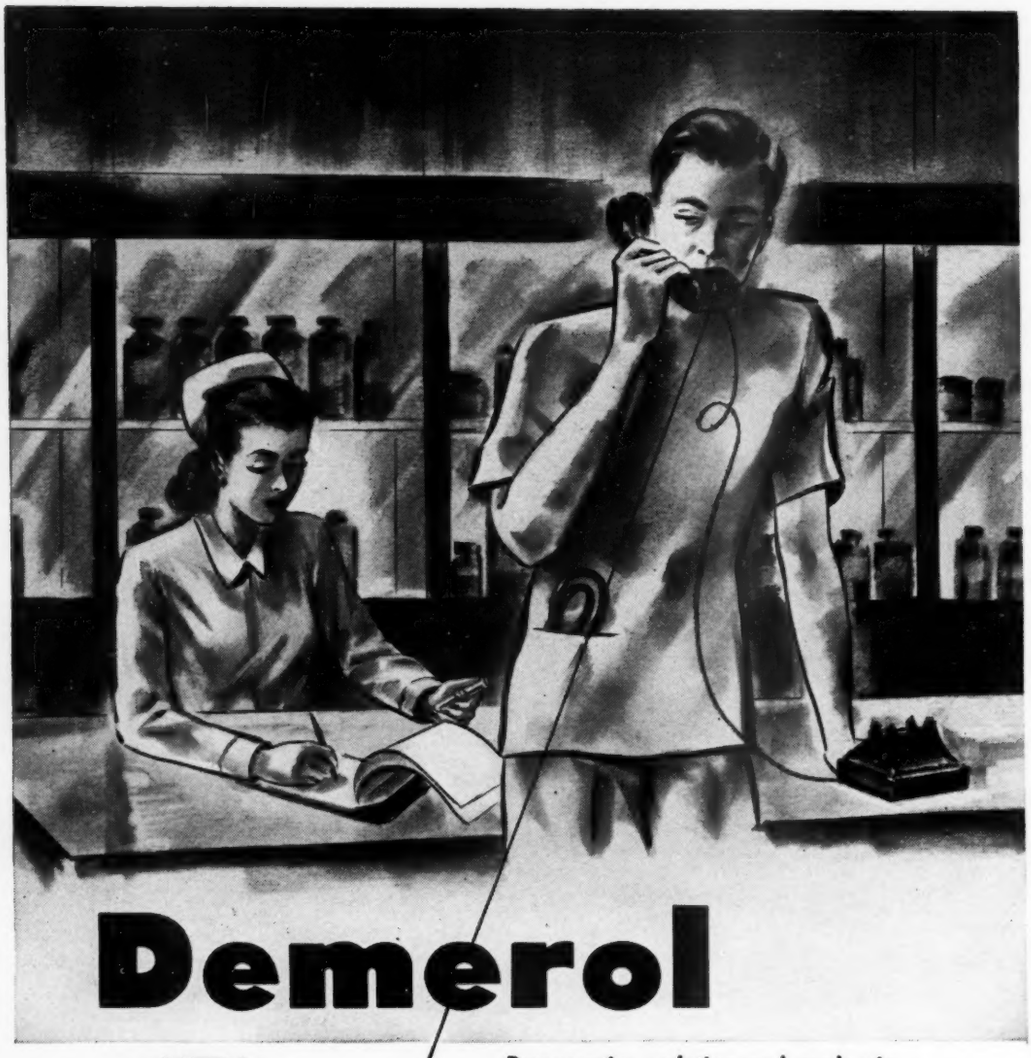

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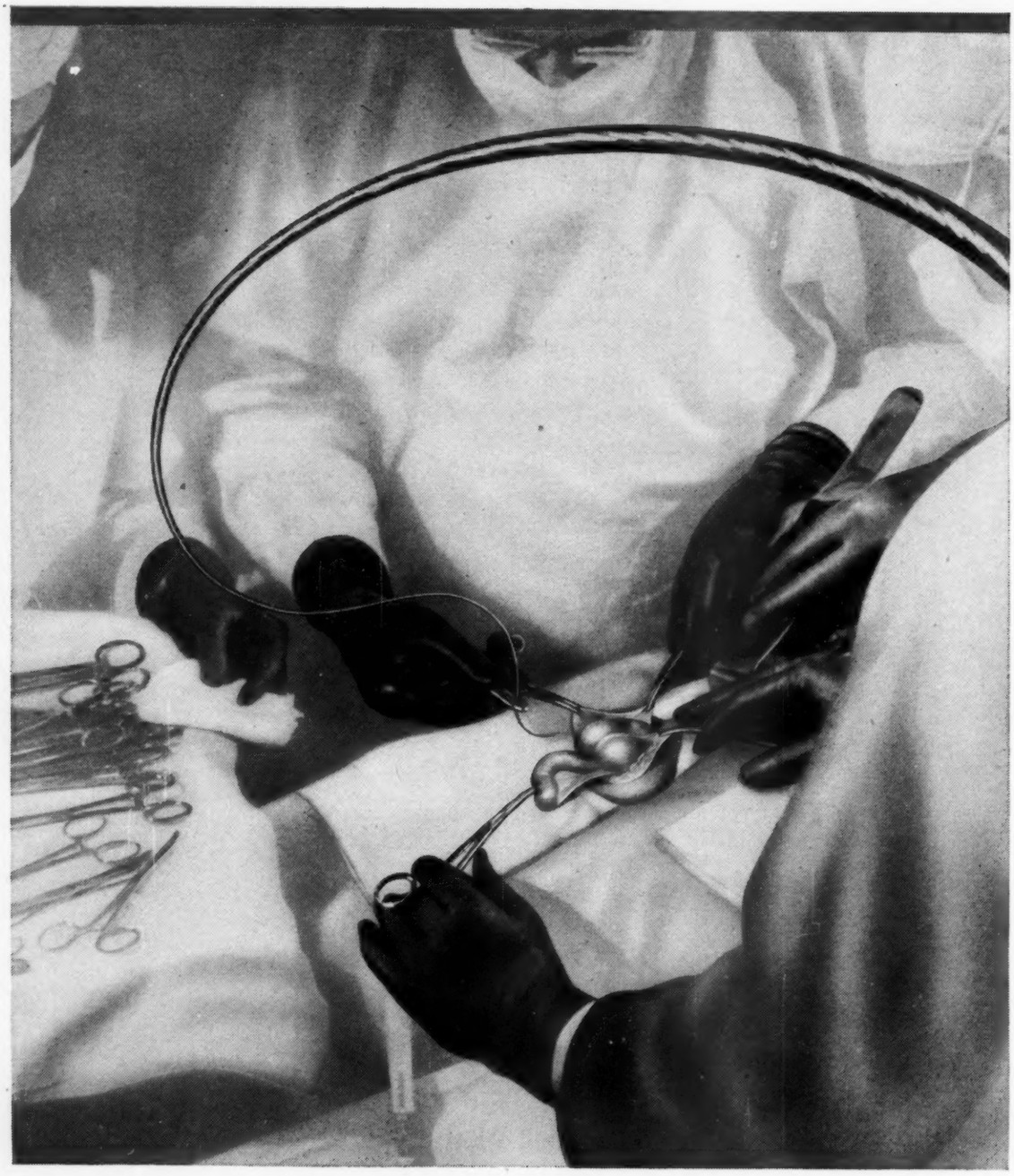

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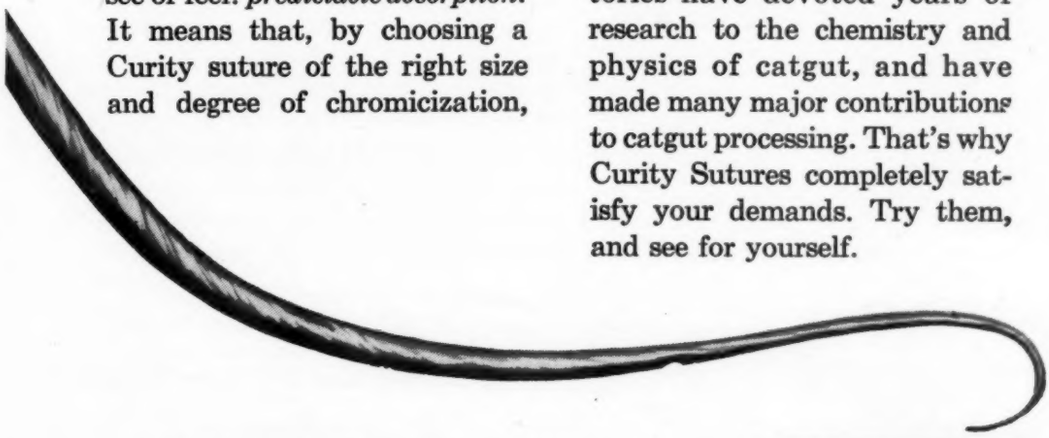

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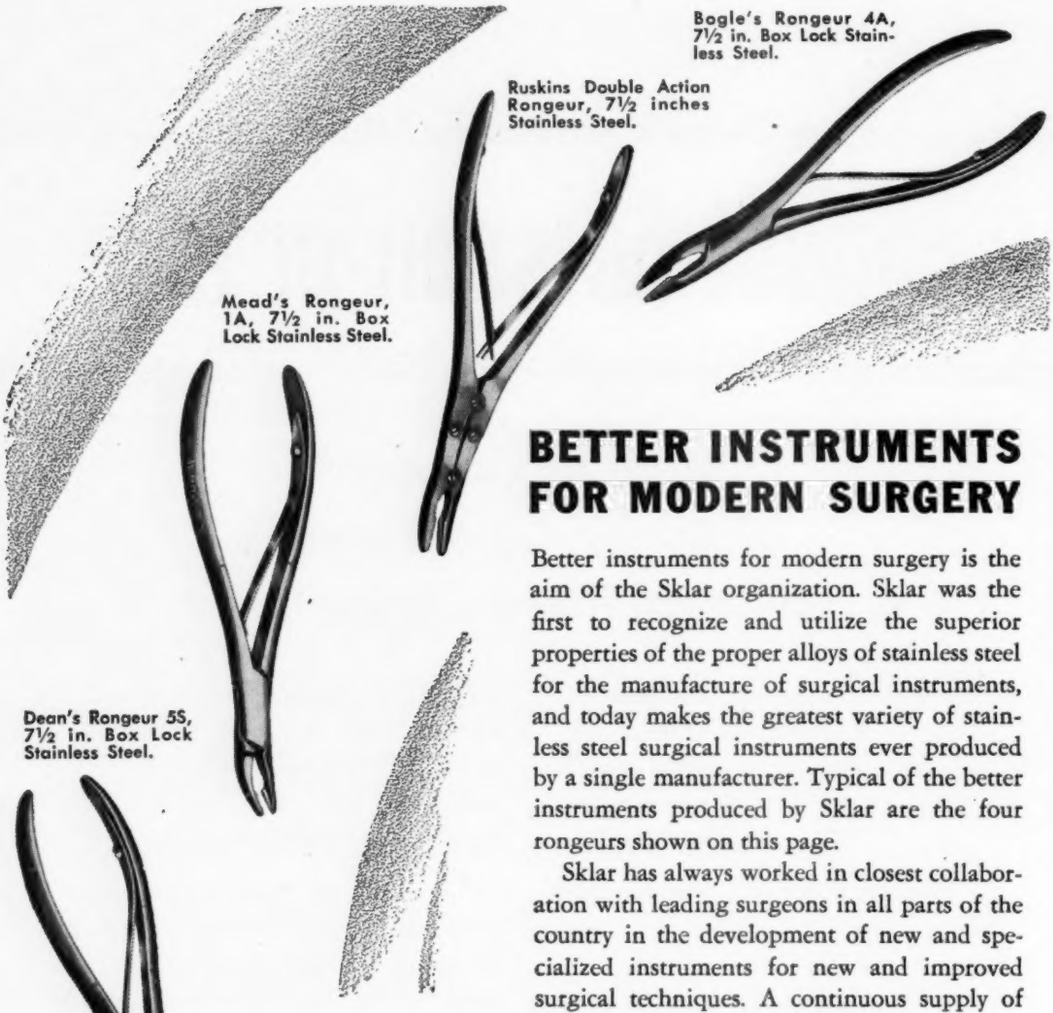
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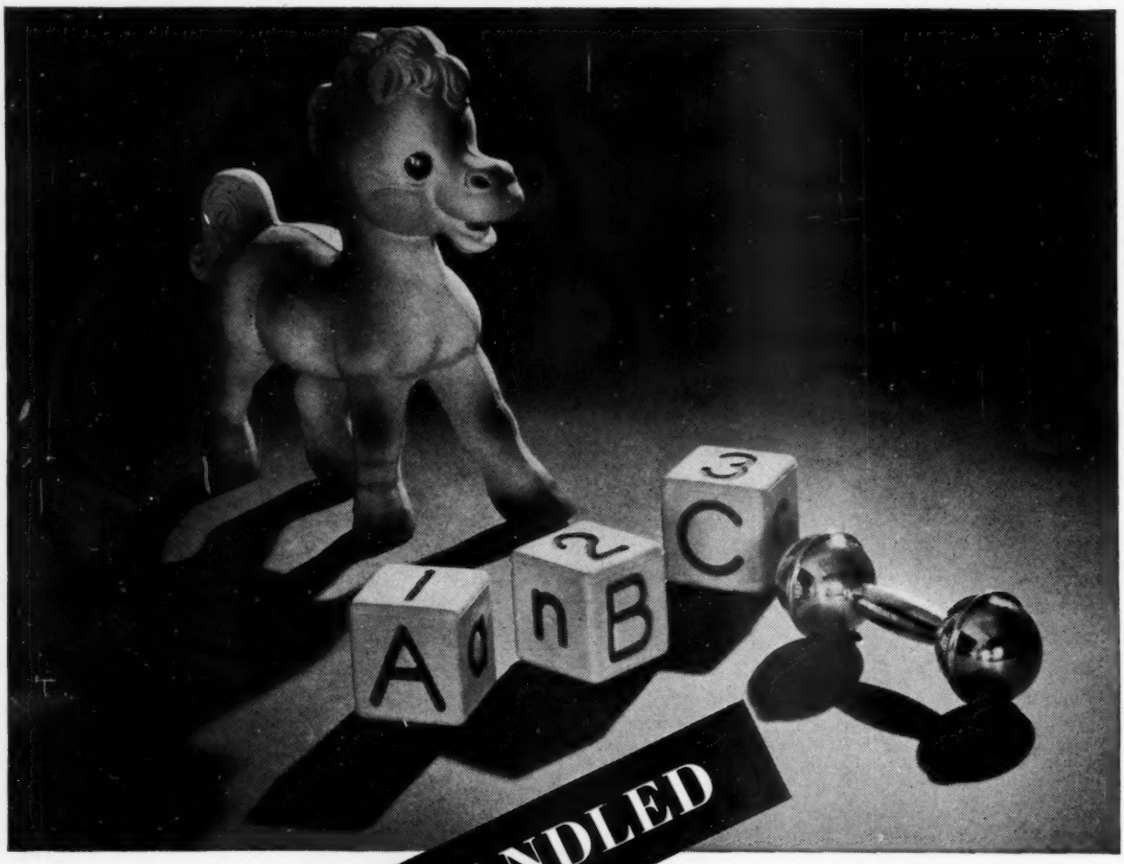

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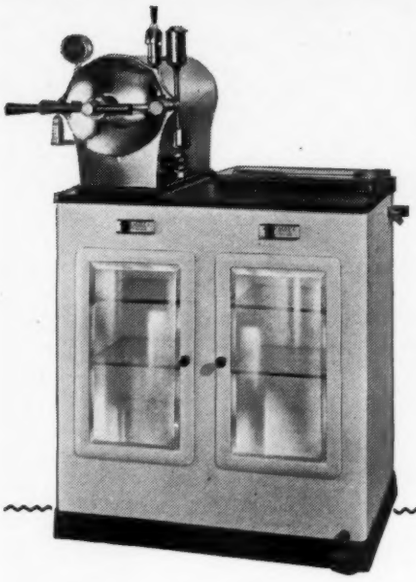

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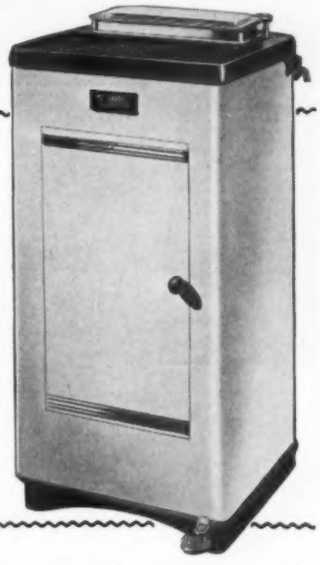

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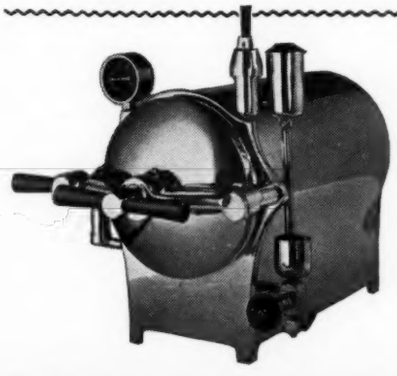

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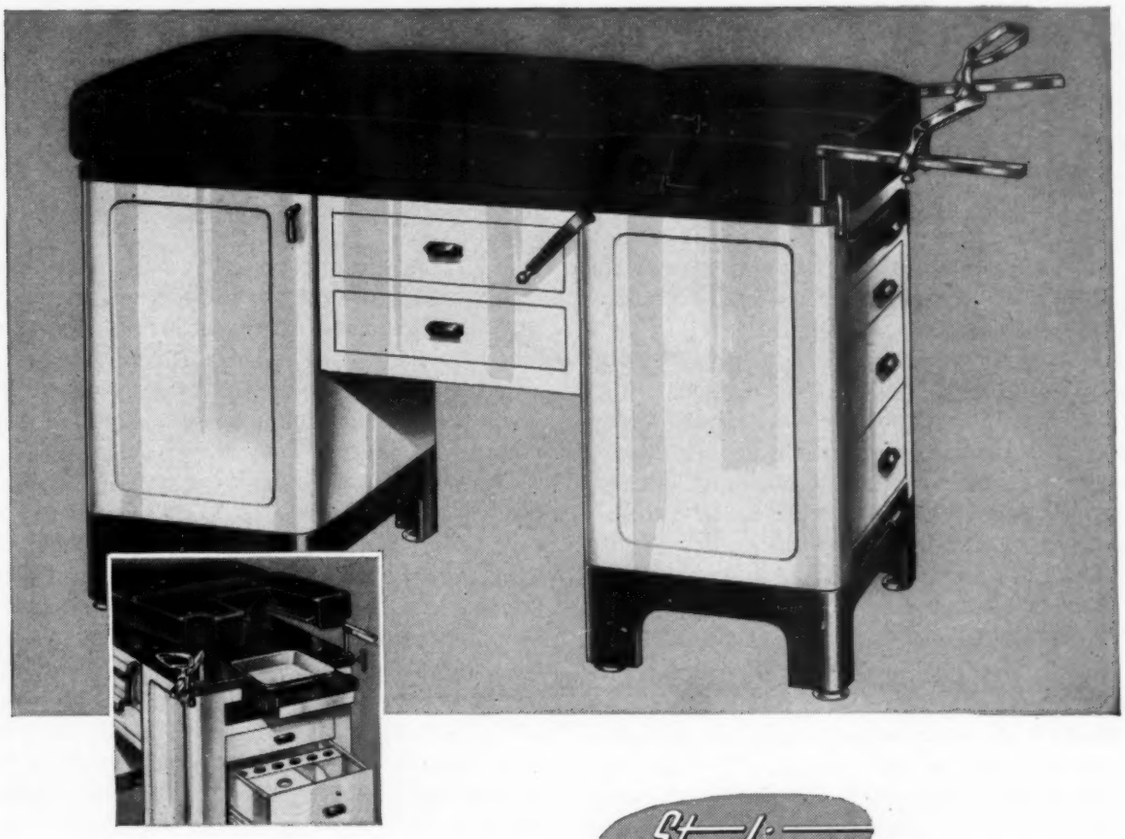

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Late in 1935, again as a result of continued animal experimentation, Egas Moniz and Almeida Lima, of Portugal, began an operative procedure—leucotomy—designed to interrupt the association paths between the frontal lobes and the rest of the brain in psychotic patients. This operation, adopted and modified by others, was introduced in the United States in 1936 by Professors Walter Freeman and James W. Watts, of George Washington University, and by 1942 some 200 lobotomies (as the Freeman-Watts operations were called) or similar operations had been performed in this country.

Frontal lobotomy was found to improve approximately 60 per cent of the patients on whom it was used. When properly done, it carried a mortality rate of about 4 per cent. Some of the patients developed convulsions. Among the patients who were not improved, some deteriorated rapidly. As a result institutional directors were skeptical of the procedure, fearing that the operative failures would fill their institutions with patients unable to care for the animal necessities of clean living. With the entry of the United States into the war and the return of large numbers of psychiatrically discharged veterans, lobotomy was greatly stimulated as a result of public demand. Families which saw their sons' and husbands' stays in mental institutions lengthening from weeks to months and even years, called frantically for the ultimate in treatment and the Veterans Administration instituted lobotomy. By 1947, over 2,000 lobotomies or allied operations had been performed in this country. An additional 2,000 cases had been done in England.

One of the unpleasant features of lobotomy was that the improved patient might have an essentially different personality following the operation. Families found their relatives often tactless and even changed enough to comment that they seemed different persons. No one knew why lobotomy sometimes was successful and sometimes failed. The fundamental anatomy and physiology of the parts of the brain were still imperfectly understood. Lobotomy could be likened to an impure drug mixture which contained a useful ingredient which could not be assayed and in which the impurities might cause unpleasant or dangerous side effects. It was in order to analyze the factors involved in this problem that Columbia started its study during the war.

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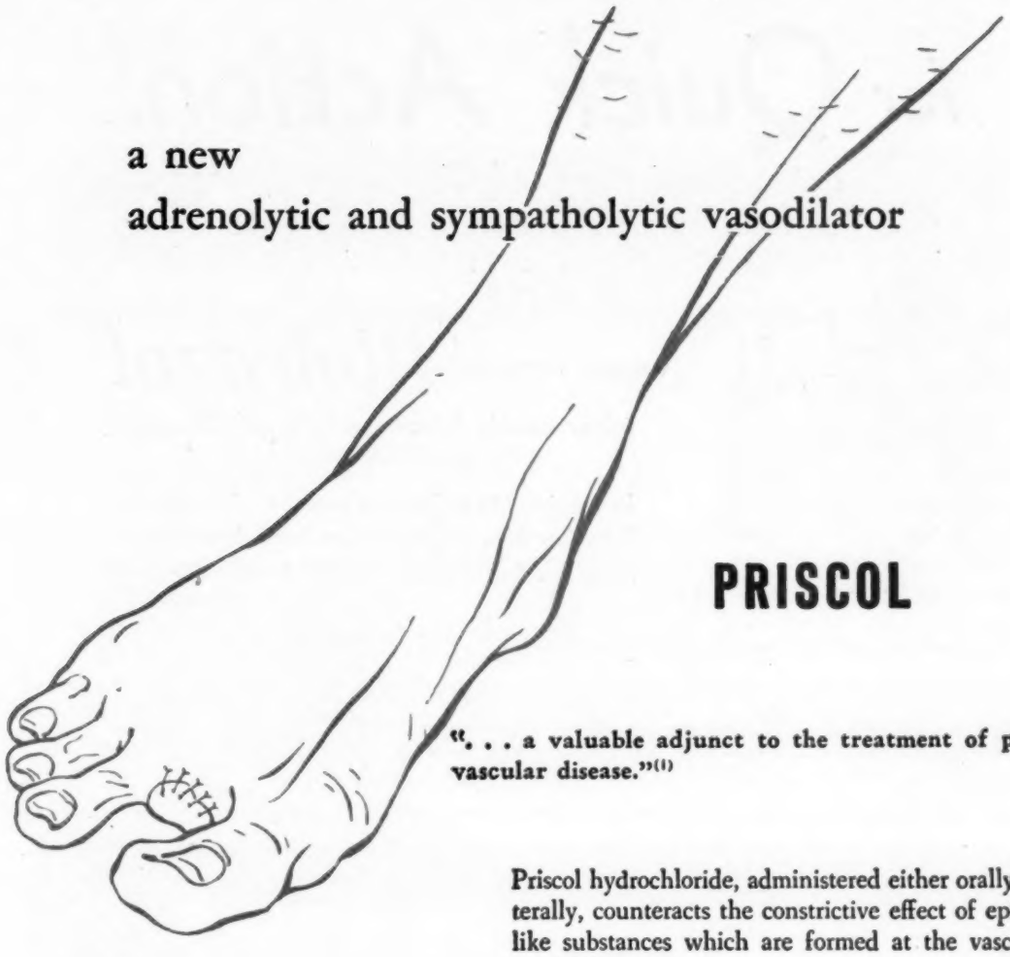
(*continued on page* 36)



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1. Grimson, K. S., Marzoni, F. A., Reardon, M. J., and Hendrix, J. P.: Surg., 23:728, 1948.

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*Int. Abst. Surg. 83:1-12, July 1946.

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*Curtis, L.: Surg. Clin. N. America 1466 (Dec.) 1947. • Shipley, E. R. and Dodd, M. C.: Surg., Gynec. & Obst. *84*:366, 1947. • Snyder, M. L., Kiehn, C. L. and Christopherson, J. W.: Mil. Surgeon. *97*:380, 1945.

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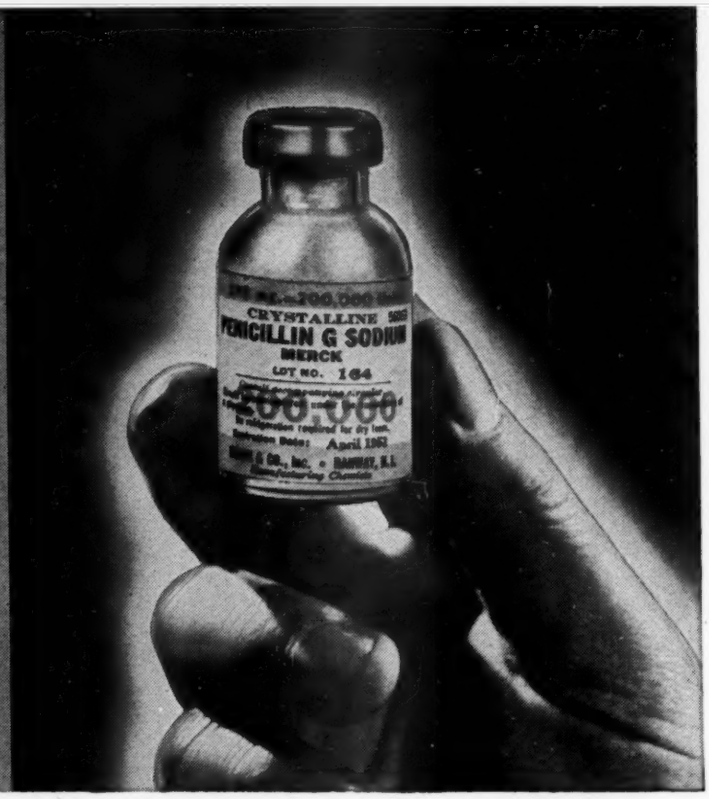

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* BOEHME, E. J. — The Treatment of Chronic Leg Ulcers — The Lahey Clinic Bulletin, 4:242 (1946)

BOWERS, WARNER F. — Chlorophyll in Wound Healing and Suppurative Disease — Amer. J. Surgery, LXXIII: 37 (1947)

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MORGAN, W.S. — Chlorophyll Therapy—A Review of 114 cases — Guthrie Clinic Bulletin, 16:94 (1947)

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A basic breakfast pattern in full accord with the principles of sound nutrition, and widely endorsed by nutritionists, includes fruit, cereal, milk, bread and butter. Tastefulness, endless possibilities for variety, and economy adapt this basic breakfast pattern to universal use by adults and children. In most communities, it can be prepared at a cost of but 15 cents per person. The hub of this meal is the cereal serving consisting of hot or ready-to-eat breakfast cereal, milk, and sugar.

The table indicates the nutrient values of this basic breakfast and the contribution made by 1 ounce of ready-to-eat or hot cereal* (whole grain, enriched, or restored to whole grain values of thiamine, niacin and iron), 4 fluid ounces of milk, and 1 teaspoonful of sugar.

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Ready-to-eat or Hot Cereal, 1 oz.;	CALORIES..... 611	202
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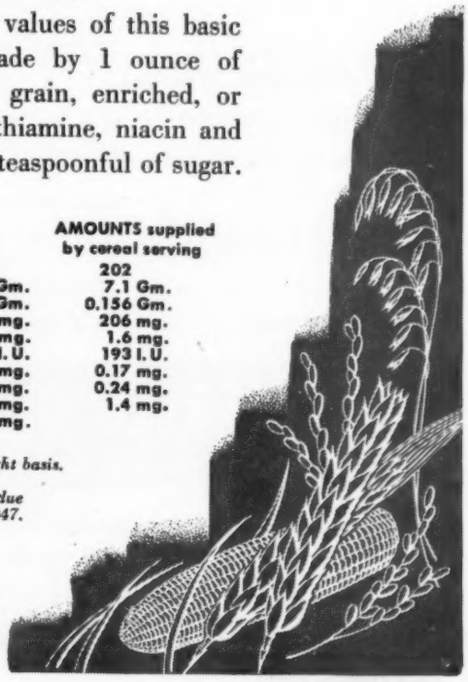
Whole Milk, 4 oz.;	CALCIUM.....0.465 Gm.	0.156 Gm.
Sugar, 1 teaspoon;	PHOSPHORUS .... 488 mg.	206 mg.
Toast (enriched, white), 2 slices;	IRON..... 3 mg.	1.6 mg.
	VITAMIN A..... 1074 I. U.	193 I. U.
Butter, 5 Gm. (about 1 teaspoon);	THIAMINE..... 0.52 mg.	0.17 mg.
	RIBOFLAVIN..... 0.87 mg.	0.24 mg.
Whole Milk, 8 oz.	NIACIN..... 2.3 mg.	1.4 mg.
	ASCORBIC ACID.. 64.8 mg.	

**Composite average of all breakfast cereals on dry weight basis.*

†Jackson, P., and Schuck, C.: Dietary Habits of Purdue University Women, J. Home Econ. 39:334 (June) 1947.



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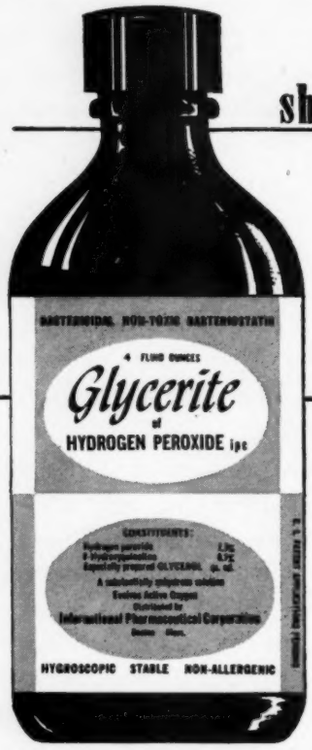

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Literature on request.

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Fifty-seventh Year of Publication

VOL. LXXVI SEPTEMBER, 1948 NUMBER THREE

Editorial

FUNDAMENTALS OF PERINEORRHAPHY FOR COMPLETE LACERATIONS

A COMPLETE laceration of the perineum is one that involves the perineal body, the sphincter ani muscle and frequently the anterior rectal wall. This distressing lesion is generally the result of childbirth and occurs in the course of difficult deliveries although it may accompany an entirely normal labor. The prophylaxis of such a lesion is most important. There are three methods in common use of avoiding a complete tear of the perineum: first, perineotomy, or median perineal incision, when a moderate amount of room is required; second, mediolateral episiotomy, performed on the side of the presenting part, right or left, or on both sides, as with bilateral episiotomy, when a great deal of room is required and third, manual dilatation of the perineum and vagina. The first two methods are preferable to the third because in the performance of manual dilatation of the perineum and vagina there is a varying degree of separation of the muscular and fascial structures under the intact mucous membrane and skin and, although at the completion of delivery the pelvic floor appears uninjured, a rectocele may develop.

There are two general methods employed in the repair of a complete tear of the perineum: the apron or flap method and the layer-suture method, with or without rectal sutures. The former method was proposed in 1878 by J. Collins Warren of Boston who presented it to the American Gynecological Society in 1882. It consists of turning down a flap which is dissected from the posterior wall of the vagina and which covers the exposed mucosa of the rectum thus permitting placing of the sutures so that they will not be in contact with the interior of the rectal tube. In the layer-suture method the initial incision takes the form of the letter H. The various structures are mobilized and the rectum is sutured with fine silk, nylon or catgut, the knots being tied within the bowel lumen; the perirectal fascia is approximated over the rectal suture line, the ends of the sphincter ani muscle are approximated to each other in the median line, the levator ani muscles, the urogenital diaphragm and Colles' fascia are united and finally the skin is closed. The skin closure is accomplished with fine catgut or fine non-absorbable material, depending on the amount of tension on the edges due to the presence or absence of scar tissue. Both methods have given excellent results and the choice between them is a matter of personal preference. From the start I have used the layer method with rectal sutures, employing interrupted sutures throughout and since the results

have been satisfactory I have continued to operate in this manner. In 1944 the end results of 110 operations showed satisfactory results in 98 per cent of the patients, 15 per cent of whom had developed postoperative complications.

During the last decade these operations have been performed with fine suture material in contradistinction to the coarse material that was formerly used. Again, careful mobilization of the tissues and approximation without tension and strangulation have resulted in better healing and in the avoidance of fistula formation. This procedure was mainly the application of improved surgical principles to that particular lesion.

The time at which this operation is performed is important. As a general principle repair of a complete laceration of the perineum may be carried out immediately after the third stage of labor if the patient is in proper condition and the surroundings are adequate for such repair. As a rule these primary repairs heal satisfactorily. If it is considered inadvisable to proceed with the operation immediately after delivery, at least three months and preferably six months should elapse before it is attempted. In the future the use of sulfasuxidine and of sulfathalidine may help to reduce the bacterial flora in the bowel and thereby be of value in promoting satisfactory healing.

Careful preoperative preparation, meticulous technic, gentle handling of the tissues, sharp rather than blunt dissection when possible and postoperative care under the immediate supervision of the operator all play an important rôle in securing satisfactory results.

Louis E. Phaneuf, M.D.

Original Articles

LUMBAR HERNIATIONS OF THE NUCLEUS PULPOSUS*

AN ANALYSIS OF 196 OPERATED CASES

E. S. GURDJIAN, M.D. AND JOHN E. WEBSTER, M.D.
Detroit, Michigan

THE common complaint of pain in the lower spine is occasionally related to symptoms and signs of nerve root compression. It has been recognized for many years that low back pain associated with lumbar or sacral root disturbance may be a transient condition suitably treated by conservative measures. It has also been known that such symptoms may warn of profound central nervous system disease, such as tumors involving the cauda equina; neoplasms of metastatic or local origin involving bone and contiguous neural structures; inflammatory conditions producing root traction and constriction; congenital malformations as in spina bifida occulta associated with intervertebral foraminal defects and root distortion or compression, and post-traumatic states with bony distortions and proliferation of scar and callous in and about the caudal canal.

Recently, attention has been focused upon a condition of nerve root compression caused by the protrusion or rupture of the nucleus pulposus of the cartilaginous disc. This is far more common than any of the other serious diseases involving nerve roots. Since 1934, when attention was called to the mechanism and treatment of this condition by Mixter and Barr,[1] a fuller understanding has gradually been achieved. Knowledge of the anatomy, physiology and pathology of the nucleus pulposus has been well established. Contributions by Bradford and Spurling,[2] Dandy,[3] Deery,[4] Grant,[5] Love,[6] Naffziger, Inman and Saunders[7] and many others have served to fix the criteria for diagnosis and settle, in general, the plan of treatment. As in all new surgical procedures there still remains some controversial questions mainly concerning the time and type of surgical treatment.

In this report attention will be given mainly to a study of 196 patients having low back pain with sciatic radiation who were operated upon in a six-year period from September, 1940 to September, 1946. Certain lessons learned from this experience will be considered. An analysis will be made of the results and a brief review will be given of certain points in the syndrome of the herniated disc.

MATERIAL

It may be seen that male patients represented 65 per cent of the series. Table 1.

TABLE 1
AGE AND SEX INCIDENCE

Sex	Per Cent	Age	Per Cent
Males	65	20–30 yr.	10
Females	35	31–40 yr.	42
		41–50 yr.	36
		51–60 yr.	10
		61–70 yr.	1

The greatest number of herniated discs occurred in the age group of thirty-one to fifty.

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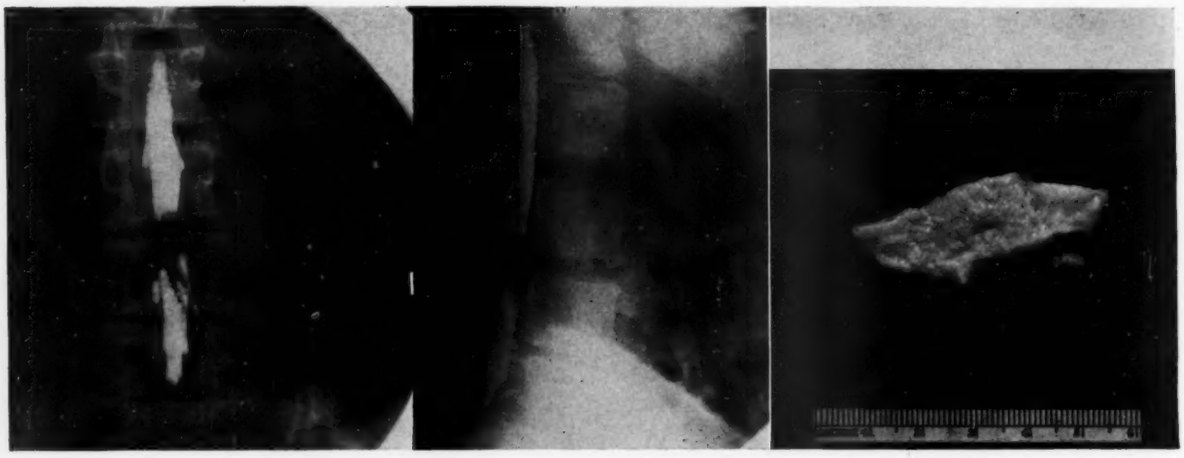
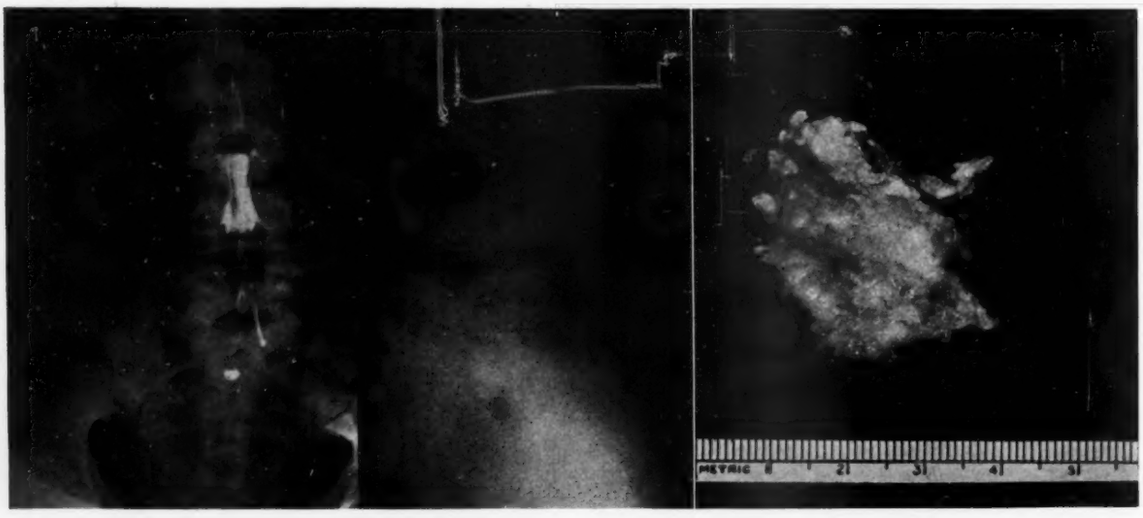


1 2

Fig. 1. Ruptured disc of third interspace causing complete block; bilateral weakness of the lower limbs with ataxia and sensory level; paralysis of sphincters.

Fig. 2. The specimen was removed in one piece and was in a rolled position anterior to the longitudinal ligament; transdural removal.

The neurologic findings may be divided into two classes: First, those patients with little or no neurologic deficit and second, patients with severe neurologic deficit. Eight among the 196 patients had severe neurologic deficit. In two patients of this group, bilateral partial paralysis of both lower limbs, with sphincter disturbance and a sensory level of hypesthesia was present. (Figs. 1 to 4). In two cases there was saddle anesthesia, sphincter paralysis and unilateral foot drop. In four others there occurred a unilateral foot drop with minimal sensory loss in the fifth lumbar dermatome on the affected side. (Fig. 5.) In this connection it should be mentioned that in two patients not included in this series the acute onset of foot drop with sciatic pain was associated with a spinal fluid total protein of 65 and 82 mg. per cent. No rupture or protrusion was noted at the fourth and fifth interspaces on the affected side. The possibility of an atypical toxic neuronitis imitating the disc syn-



3 4

Fig. 3. Pantopaque myelogram showing complete block at the fourth interspace; bilateral foot-drop, sensory level, and sphincter paralysis were noted.

Fig. 4. Specimen was removed in one piece; transdural removal; similar to conditions described in Figure 2; this material was found "rolled up" anterior to the longitudinal ligament.

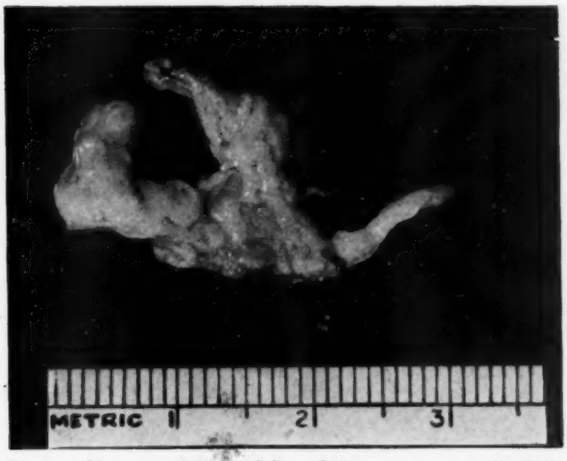


FIG. 5. Ruptured disc of fourth interspace on the left associated with a foot-drop and sensory loss of the fifth lumbar dermatome. The specimen extruded in one piece.

drome presents itself. Three patients manifesting symptoms suggesting ruptured nucleus pulposus were found to have sacral chordomas and four others, cauda equina tumors. (Figs. 6 to 8.)

TABLE II
OPERATIVE FINDINGS

Ruptured or protruded discs	146
No disc herniation found at operation	28
Two disc herniations found (L4-5; L5-S1)	9
Massive rupture of disc	8
Calcified disc	5

It is interesting to note that the development of severe neurologic dysfunction was very rapid in five of the eight patients with massive rupture (two to ten days).

TABLE III
LEVEL AND SIDE INVOLVED

Levels	Per Cent	Side	Per Cent
L3–4	1	Left	54
L4–5	38	Right	45
L5–S1	61		

In 146 patients, operation involved single herniation. (Fig. 9.) Nine patients had two abnormal discs (Fig. 10), a single calcified protrusion was found in five patients and massive rupture occurred in eight patients. In twenty-eight patients no disc protrusion was found. (Table II). The left side was involved in 54 per cent of the

FIG. 6. Protruded discs at the fourth and fifth interspaces on the left. Following the removal there was some improvement of the leg component of the pain. The patient continued to complain of intractable low back pain.

patients and the right side in 45 per cent. Thirty-eight per cent of the abnormalities occurred between L4 and L5, 61 per cent between L5 and S1 and only two patients, or 1 per cent, had lesions at L3 to L4. (Table III.)

TABLE IV
ABNORMALITIES IN TWENTY-EIGHT PATIENTS WITH NO DISC PROTRUSION

Varicosities of outgoing root	12
Root compression by contiguous tissue	7
Herniation of cauda equina filament through dural opening	1
Normal	8

Among the twenty-eight patients with the protruded or ruptured disc syndrome in whom no defect of the disc was found (Table IV), varicosities of the outgoing root were noted in twelve patients. In seven patients it was thought that there was root compression by contiguous tissue and in eight others the relationships appeared normal. Among those with vari-

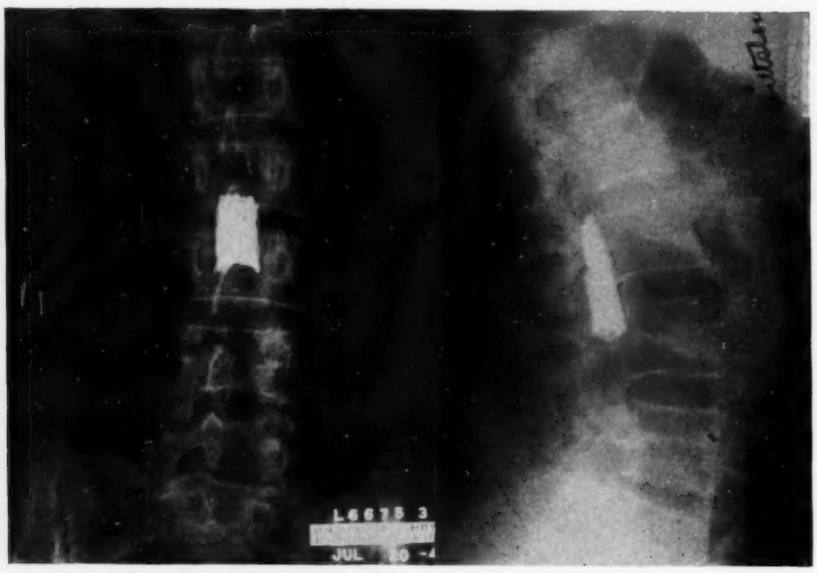


FIG. 7. Pantopaque myelogram in the case described in Figure 6 showing complete block at third lumbar level; spinal fluid total protein 75 mg. per cent.

cosities the gross pathologic picture was quite typical in every instance with epidural hemangiomatous tissue involving the outgoing nerve root, either at the lateral or medial aspect of the outgoing nerve trunk or surrounding it.

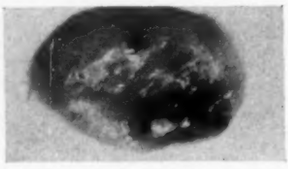


FIG. 8. Meningioma removed in previous case, with complete cessation of symptoms.

FIG. 9. Herniated disc removed "piece-meal."

All patients had spinal fluid examinations. In the greatest majority the total protein was slightly elevated, the average being 50 mg. per cent. In only four patients was the total protein above 100 mg. per cent. (Table v.) Pantopaque or lipiodol myelography was carried out in thirty-one patients. In twenty-one the myelographic and operative findings corresponded. In the remaining ten there were false-positive or negative findings. Subarachnoid air myelography was not diagnostic in our hands.

TABLE V

SPINAL FLUID TOTAL PROTEIN

Average	50 mg.%
Above	100 mg.%, 2%
Below	30 mg.%, 10%

Every patient had roentgen studies of the spine made and in twenty-seven of the group significant coexisting spinal abnormalities were noted. In twenty patients there was a narrow disc but only in seven did this correspond to the affected interspace while in thirteen the narrowing occurred at other than the affected interspace. (Table VI.)

The type of operation performed in this series is tabulated in Table VII. Bilateral laminectomy was performed in twenty-three patients. In 121 patients the opera-

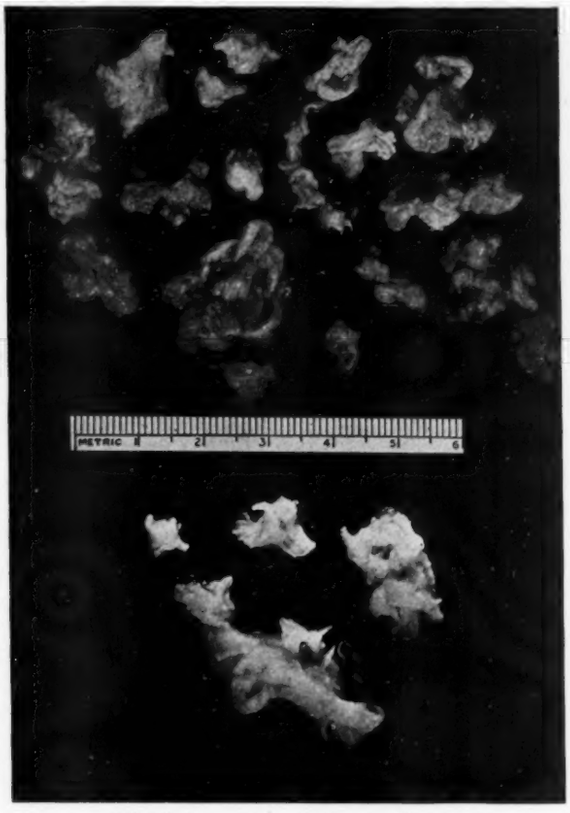


Fig. 10. Multiple ruptured discs; above pieces removed from the fourth interspace; below from the fifth interspace; routine exposure of both fourth and fifth interspaces is very worth while.

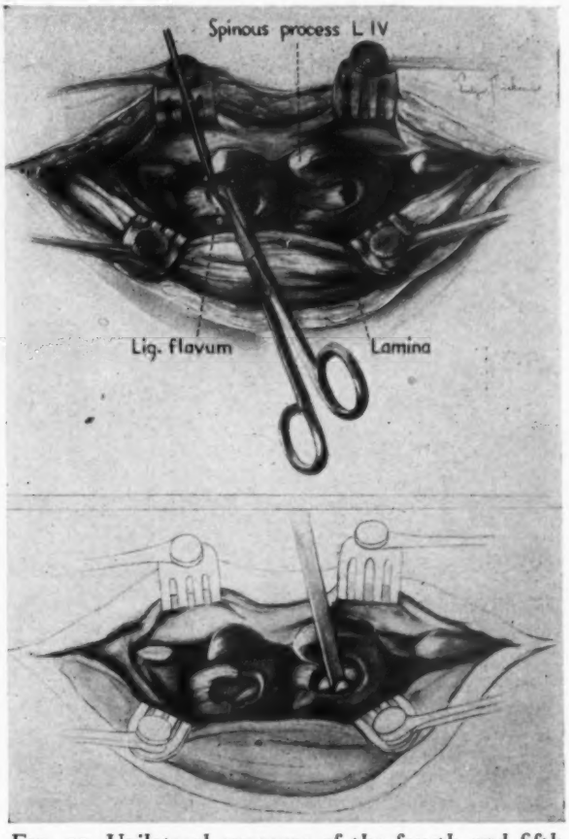


Fig. 11. Unilateral exposure of the fourth and fifth lumbar laminae. Excision of the posterior and lateral portions of the lamina until the anterior border and the lateral attachment of the ligamentum flavum are visualized; excision of the ligamentum flavum followed by inspection of the outgoing roots and the intervertebral discs.

tion consisted of hemilaminectomy and exposure of the fourth and fifth interspaces on the affected side. (Fig. 11.) The posterior and lateral borders of the fourth and fifth lumbar laminae were ronguered away until the superior edge and the lateral attachment of the ligamentum flavum were visualized. A blunt hook was passed under the superior border of the ligamentum flavum which was excised. Care was taken to remove completely the portion attached to the spine laterally, otherwise a shelf of ligamentum flavum would obstruct the view in exposing small protrusions. Among those with bilateral laminectomy eight massive discs were removed transdurally and one extradurally. Combined hemilaminectomy at the fourth and fifth interspaces on the affected side with fusion of the lumbosacral spine was carried out in fifty-two patients. The fusion usually consisted of the use of a tibial graft, cancellous bone and osteoperiosteal graft. The nonlaminectomized side was mainly used for the graft. In a few patients the procedure advocated by Moore[8] was used, the graft being applied with the patient in flexion

Table VI

Significant X-ray findings

1. Significant spinal abnormalities (Arthritis, spondylolisthesis, iliac ostitis, sacroiliac arthritis, deforming spondylitis)	27 cases	
2. Narrowed disc spaces	20 cases	
Affected disc	7	
Unaffected disc	13	
3. Contrast media studies	31 cases	(15%)
Accurate	21	
False-positive	5	
Normal (disc present)	3	
Wrong level	2	

In three patients of group 1, no disc was present.
Air myelography (subarachnoid), unsatisfactory

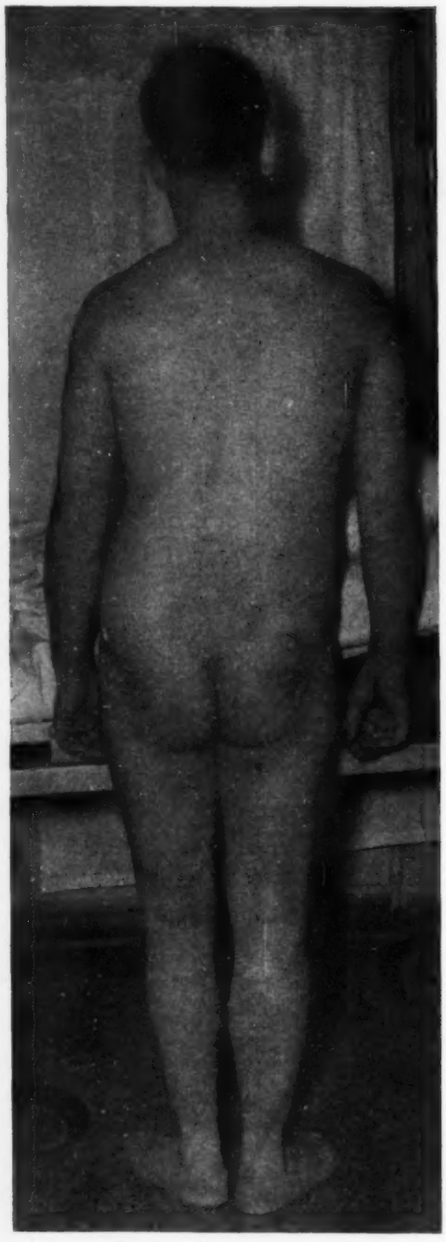


FIG. 12. Ruptured nucleus pulposus of fourth interspace on the left side causing a list to the right. Also note the difference in the size of the two legs; the left leg is atrophic.

to get the maximum separation of the vertebrae posteriorly. Most of our fused patients were ambulatory in two weeks.

In Tables VIII and IX, follow-up studies of eighty patients are reported. Ordinarily the results have been satisfactory. Compensation cases have not fared as well as private ones. The convalesence was short

FIG. 13. Lipiodol study of the lumbosacral dural sac. A ruptured nucleus was visualized at the level of the fifth interspace on the right side.

TABLE VII

TYPE OF OPERATION

Laminectomy bilateral	23
(Transdural removal 8)	
Hemilaminectomy (partial)	121
Combined operation with fusion	52 (26%)
No disc found in eight of the fusion patients	

TABLE VIII

FOLLOW-UP STATISTICS IN EIGHTY PATIENTS

	Cases	Poor Results	Compensation
6 months–1 yr	31	4	3
1–2 yr	23	2	1
2–3 yr	14	2	
3–4 yr	8	0	
5 yr. plus	4	1	

TABLE IX

RESULTS IN EIGHTY PERSONS

	Per Cent
Excellent	43 (Essentially cured)
Good	25 (Greatly improved; working)
Fair	20 (Improved; working)
Poor	12 (Unimproved; not working)

Of the twenty-five fused patients results were:

	Per Cent
Excellent	36
Good	32
Fair	24
Poor	8

(two to six weeks) or long (two to four months). We divided our results into four groups: excellent, good, fair and poor. By excellent we mean complete recovery. Good results are obtained in patients who may have attacks of pain on exertion but which are not serious enough to incapacitate them. Fair results are characterized by patients who carry on with their work in a lighter job, with backaches or leg pain to contend with from time to time. Poor results are obtained in those who are made no better by the operative intervention. There has been an occasional instance of a patient with an excellent result having a non-incapacitating recurrence of symptoms after three or four years.

Nine in this group had secondary operations, three were patients from other clinics and six were our own cases. Among the latter, five were re-operated upon at our hospital and one was operated upon in another clinic. The results among the re-operated group have been satisfactory with the exception of one patient in whom a cordotomy was performed as a last resort. Among the re-operated patients, material was removed from the same interspace in two instances and from another interspace in the remaining three. In the patient re-operated upon at another clinic a nerve root was found to protrude through a small opening in the dural sac with a spurious meningocele. The original opening in the dura, which had been closed with silk, had been utilized to drain the contrast medium used for myelography.

COMMENTS

The pathologic conditions of the intervertebral disc include (1) a posterolateral bulging of the nucleus through a weakened portion of the annulus fibrosus, producing a protruded disc; (2) rupture of the nucleus through the annulus and the posterior longitudinal ligament, commonly designated as ruptured disc; (3) a degenerated nucleus and annulus causing reflex pain by internuncial communications in the spinal cord in the same dermatome as the outgoing nerve, producing a referred pain in the back and sciatic distribution and (4) Schmorl's nodes or rupture of the nucleus into the body of the vertebrae above or below, giving a characteristic roentgen appearance.

The symptoms in posterolateral herniation of the nucleus include pain in the lower back with radiation into one or both lower limbs along the posterior aspect of the hip, thigh, posterolateral aspect of the leg and the foot in some cases.

The pains are typically sharp and shooting in character, at least part of the time, and are made worse by coughing, sneezing or straining at stool. Occasionally coughing or sneezing has no influence upon the complaints. The backache may precede the sciatic radiations by months or years and then again the sciatic component may be present without the low back pain. During the acute attack the pain may be intractable, producing total disability, gradually subsiding under rest to become subacute, chronic or completely remissive. The less acute back pain may have a "catch-like" quality, is often worse at night and is eased by walking or sleeping in a chair. Paresthesiae and hyperesthesiae may be noted in the affected lower limb.

In patients with minor neurologic deficit there may be pain on straight leg raising; a list away from the side of the lesion (Fig. 12); pain in the lower back upon compression of the neck veins or upon forward flexion of the head and neck and pain upon bending backward or toward the lesion. Percussion of the involved interspace may produce typical radiations of pain.[2] The knee jerk may be lost with third interspace involvement. Weakness of the extensor hallucis longus occurs with involvement of the fourth interspace; the achilles jerk is frequently lost with a rupture at the fifth interspace. Sensory defects may be minimal, usually found along the lateral aspect of the leg with some involvement of the big toe, with fourth interspace lesions. With fifth interspace involvement the sensory deficit

involves the lateral three toes and the corresponding portion of the foot. It should be emphasized that in some cases the neurologic findings are entirely negative, except for pain on straight leg raising.

Severe neurologic deficit as foot drop, saddle anesthesia and sphincter disturbance are associated with massive rupture at the fourth and fifth interspace. Paralysis of both lower limbs with varying degrees of sensory loss and sphincter dysfunction are found with rupture at the level of the third or fourth interspaces.

Roentgen examination is an important adjunct in diagnosis. The presence of sacroiliac arthritis, spondylolisthesis, lumbar spinal arthritis, Marie-Strümpell disease, metastatic lesions of the lumbar spine, tuberculosis and sacral chordoma may thus be determined. It should be emphasized that a ruptured or protruded disc may coexist with spinal arthritis, sacroiliac arthritis, iliac ostitis and spondylolisthesis. The presence of a narrowed intervertebral disc does not necessarily indicate the level of a ruptured or protruded nucleus.

Our patients have been punctured for study of the spinal fluid. The total protein is frequently slightly elevated. Only occasionally is it over 100 mg. per cent. The use of myelography is worth while (Fig. 13) in the doubtful case to determine the presence of multiple lesions or rule out a neoplasm. In our hands there is an error of 25 to 30 per cent counting false-positives and false-negatives.

Indications for operation may be classed under two headings: First, in patients with severe neurologic deficit. In this group immediate operation is indicated. Second in those patients in whom the chief complaint is disabling pain. Operation is usually not the method of choice in patients having a first attack of backache and sciatica. If symptoms persist for many months in spite of leg traction, therapeutic injections along the lower spine, boards under the mattress, caudal injections, lumbosacral support or a body cast, operation may be advisable. In patients with recurrent attacks of backache and sciatica and in those subjects with a history of backache for many years with recent sciatic radiation for the first time, operation is justified.

Twenty-six per cent of our patients have had spinal fusion. Fusion has been used in patients who in addition to the herniated nucleus syndrome also had evidences of an unstable back (lordoscoliosis of the lower lumbar spine, sacralized fifth lumbar vertebra, unstable fifth lumbar vertebra as evidenced by asymmetrical facets) and when the syndrome is associated with spondylolisthesis. Patients with long continued and intractable backache with sciatic radiation are explored for a protruded or ruptured disc followed by fusion. Fusion is performed after exploration in patients who toil at hard labor, with bending and lifting essential in their occupation.

Operative Technic. Partial hemilaminectomy, excision of the ligamentum flavum and the ruptured disc, with curetting of the interspace, is quite adequate. The fourth and fifth interspaces are routinely explored. In patients with severe neurologic deficit when a massive protrusion is found extending into the spinal canal, bilateral laminectomy and either transdural or extradural removal of the disc is the procedure of choice. This is preferable to bilateral hemilaminectomy since the block may be due to an intradural or cauda equina tumor. In the absence of a ruptured disc it is then a simple matter to explore the dural sac. In patients who are fused, hemilaminectomy at the fourth and fifth interspaces of the affected side has been followed by tibial massive graft, osteoperiosteal and cancellous bone graft. This combined operation has always been performed with an orthopedic colleague.

The pathologic picture disclosed at operation has been varied. A ruptured or protruded disc, varicosities about the nerve root and, in some instances, compression of the outgoing nerve root by surrounding tissues has been verified in the greatest majority of cases.

The postoperative behavior of patients with herniation of lumbar discs varies. The convalesence in some cases is protracted with eventual recovery. Many are only freed from incapacitating symptoms. Others make a complete recovery.

CONCLUSIONS

1. A narrowed intervertebral disc by x-ray does not necessarily indicate a rupture of the disc.

2. Myelography is misleading in 25 to 30 per cent of the cases, either by being falsely positive or negative.

3. Pain may be the only indication of a herniated disc in some cases. A typical combination of signs and symptoms is obtained in most cases of ruptured disc.

4. In most cases, operation may be deferred in the first attack of low back pain with sciatica.

5. Massive ruptured disc with severe neurologic deficit deserves immediate operative attention.

6. Fusion has been used in this series of cases with spondylolisthesis, unstable fifth lumbar vertebra, long history of backaches and in some patients who toil at hard labor.

7. Results on the whole have proven satisfactory. Cases combined with fusion and those with small hemilaminectomy have shown approximately the same results.

8. Exploration of the fourth and fifth interspaces routinely on the side of the pain as suggested by Dandy is a satisfactory procedure.

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FADS AND FANCY IN TREATMENT OF PEPTIC ULCER*

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SEVERAL years ago at a meeting of one of the gastro-enterologic societies an eminent gastro-enterologist from the South announced in a dramatic way that there and then he wished to announce a new cure for peptic ulcer. As a sort of build up he unfolded a story of how this new cure, and he was quite sure that it was going to be miraculous, had been given to him by an old lady of the Texas hinter land whom he had come across while on a hunting trip into the back country.

The cure consisted of lying down after each meal and rubbing some hot bear grease across, onto and into the epigastrium or wherever the pain might be located. The gentleman said that now that he had announced his miraculous cure he was going to sit back and watch developments. He fully expected an onrush of the press and he was quite sure that their interest in the welfare of the people would cause them to carry the message of this new cure into every home and hamlet in these United States. The next development which he foresaw was an onslaught on the part of the commercial purveyor of anything that would help anybody's ailment, particularly if there was any angle to it that would make a cash register ring lustily.

In the ordinary course of the evolution of his discovery he felt sure that some one would announce that his particular brand of bear grease was better because the bear had been shot at night or by moonlight when he was in a tranquil mood, and his endocrines had not had any chance to exercise any constricting or frustrating influence of fear and such. He felt quite sure that some concern would announce that they had hired a famous Canadian bear trapper and that their bears were humanely trapped, then installed in cages and fed the proper vitamins and hormones. Then the bears would be taken completely unawares and shot through the brain with one bullet and one only, therefore their grease was best.

Quite naturally, the doctor was being facetious but perhaps there was a point to his remarks. The treatment of peptic ulcer has at times assumed the aspects of the acme of the ludicrous and such a fantasy as he pointed out has its analogy even down to our present super modern methods. Need I refer to those patients who suffered, God knows what, offense not only to their esthetic sensibilities but to their physical as well when they tried to down the super-prepared mucin in their laudable efforts to obtain relief of their symptoms. Surely the picture in recent medical journals of one of the men of achievement sitting nonchalantly in a well padded and most comfortable looking library chair reading a book, with a Levine catheter coming out of his mouth attached overhead to a glass jar containing a "new" antacid in such manner that a continuous 60–72 drop per minute is supplied within the stomach makes one stop and wonder. A cynic suspects immediately that the gentleman in the picture is far too contented looking to be an actual sufferer from ulcer. Just possibly he is there as a paid model getting a pretty good fee for the short time he has to endure the discomfort, at least his appearance suggests just that. One would think that alone would destroy the effectiveness of the advertisement. The poor fellow who really has an ulcer has to live with the thing, has to take it to the bathroom and life

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for him does not consist of sitting in a chair reading a book. For him as for all of us there are human processes to be taken care of in the course of a day thereby leaving precious little time for the reading of books under such "pleasant" surroundings, such being brought about only if you use this particular preparation.

Surely all of you can recall when not so long ago one of our national weeklies—a "must" reading in too many American homes—came out in its rather loosely conducted column headed "Medicine" with a review of an article advocating the use of a war-developed soap substitute, a detergent, as a new method of treating ulcer. Surely some must have seen patients who had read the article and decided to try it on their own and then came in frothing at the mouth and asking "why"? Leaving aside the Texas doctors' satire at our methods of handling ulcer, let us for the moment recapitulate some of the well known basic facts about ulcer defying the dislodging attempts of time.

Like every other phase in medicine our concepts as to the etiology and therapy of ulcer, if charted, would show a procession of peaks and valleys, illustrating how one idea reached its peak and acceptance, was tried and found wanting and sank into the valley of disuse and oblivion.

Since man first recorded his doings and his daily life by chipping away on stone, we possess a written record of ulcer and what was done for it, and at times this record has been truly fantastic and has run from the frankly ludicrous to the terribly lethal.

One or two of the hundreds of ideas advanced have been of some symptomatic benefit to the individuals involved. Some of the ideas have been propagated by well meaning crackpots with a crusading idea to do good in their own way for their suffering fellow men; some were prompted by a frustrated desire to get into print and into the limelight; others were there for monetary gain. Profiting as manufacturers by using the poor busy general practitioner as a pawn, pharmaceutical houses have much not to be proud of.

If one stops but a moment and searches into the plight of the general practitioner, one will feel very kindly toward him and forgive him his errors. He is apt more times than not to be a purist and idealist; he has on his hands a stubbornly refractory case of ulcer which has not been doing well. Maybe the patient is a power in the community, influential and all that; maybe he is just plain Joe Doakes, but no doctor at any time wants to chalk up a failure if he can help it. He has tried all the orthodox methods but they have not worked out; so grasping at any straw, he has heard or read somewhere about this or that, so why not give it a whirl? He is desperate, his back is to the wall; he has not time to investigate for himself scientifically; besides he assumes that the investigating has been done by those advocating the regimen. The general practitioner far and wide has nothing to apologize for; the end is not even in sight; there will be more fads tomorrow and the day after tomorrow and not necessarily new ones either.

What of the patient? Inadequately informed and befuddled because of a spurious authoritativeness to each pronouncement, he has a long journey ahead of him through the school of trial and error. He finally arrives full of bitterness and rancour—an enemy of the physician and of the profession in general—misguidedly hoping that the doctor gets strung up by his heels in one of the socialistic schemes of practice advocated everywhere nowadays. It is a situation in which "you pays your money and takes your choice," but there is no choice.

Delving into the history of the past, the earliest description of the symptoms of ulcer that I could find goes back to a manuscript dated 3500 B.C. I have to be exceptionally careful in these bibliographic references because I have medical friends interested in the same field and should one be in error I am very sure to hear of it.

My next reference is to the bronze and clay tablets of the Babylonian and Assyrian civilizations, from which museum experts have been able to decipher the hieroglyphics describing the daily life of the people. In one of these descriptions mention is made of "a passion of the cardia," a burning with a crescendo-like character climaxing in massive hemorrhage and death. That was the clinical course of ulcer as the Babylonians and Assyrians knew it.

From the Egyptian and Arabian civilizations which came after, only inferential evidence of their knowledge of ulcer can be found. Elaborate and detailed dietary directions featuring the use of mares and asses milk at frequent intervals and in liberal quantities are found. In all respects the diets recommended differ little from those we hand our ulcer patients today. When one progresses on to the Greek and Roman civilizations and reads of the orgies of gluttony, of the lustful, sensuous, satiating daily life, one is apt to think: how could these people escape having ulcers? But one reads further and learns that if you were in tune with the times and what the well dressed man or woman carried, you had your own private feather tickler; and when you were a bit uncomfortable and distended about the midriff, you did not have to leave the table. You summoned one of the attendants who brought a basin and then taking your wrought gold, filigreed silver or jewel handled feather you tickled your soft palate until up come whatever was bothering around the waist line and you turned right around and started eating again—strictly good etiquete. Then you stop to speculate and muse, surely there must have been plain, simple, common poor folk in Athens and Rome who never got to such feasts. What did they do? The historians do not tell us.

Although there is much in between, for purposes of brevity we pass quickly to the year 607 A.D. when one Paulus Aegeus sat himself down and wrote a truly objective treatise on ulcer of the stomach, its symptoms, his speculations as to causes and his approach to its treatment which included the use of clay or, in its more refined modern day materialization, kaolin or colloidal kaolin. So much for a minor deviation into the medical history of ulcer.

The patient who has an ulcer today looks around him and wonders why his neighbor can eat nails and he himself has difficulty digesting milk and he asks the medical profession, why? The profession to the best of its ability tries to answer that question on the basis of constitutional predisposition or its twin "ulcer diathesis" and in words of few syllables answers the patient. You were born doomed to have an ulcer and you would have had one no matter what you had done. The patient still bewildered again asks, why? The only answer available approaching rationality is that there is biological lack of integration or a hormonal imbalance within your blood stream; certain chemical substances are being overproduced or underproduced and these are acting by way of your nervous system or your glandular system to produce this ulcer condition. The patient still asks "why"? The very multiplicity of ideas as to cause only throws into the limelight what little we have to offer as to "why."

Only a few weeks ago I listened to a rapturous almost mystical discourse on the only logical cause of ulcer being an anatomic disarrangement of the normal relationship between the pylorus of the stomach, the superior border of the duodenum, the left lobe of the liver and the vertebral column, and verily I received the impression that the speaker assumed that such a theory was his own original brainchild unmindful of Cohnheim's enunciated same theory which has been kicked around for approximately the past hundred years. The speaker, with a chip on his shoulder, assumed the martyr's cloak and announced to his presumably experienced and educated audience that he did not expect to receive credit for this marvelous discovery during his lifetime, as history

showed that most medical martyrs were pilloried and crucified but that notwithstanding he was going to carry the cross.

Occasionally in gastrointestinal practice one runs across an extremely practical-minded engineer who has his own ulcer problem. Adhering to his engineer training, he has conducted a little independent research into his problem and comes up with the finding that we as physicians attempting to solve his problem have very little knowledge on which to go, and that much of what we have is confusing and not encouraging to even make a start on treating him. You see he has read everything or at least thinks he has. Accustomed to reducing all problems to mathematics, to the exact dovetailing of one piece of material into another, he vouches the opinion that perhaps we should call in engineers to help us, particularly in the field pertaining to materials. He believes that after some study as to gradients, position, etc., they might have something to offer. In retrospect it would not be difficult to agree with him; maybe he has something.

It has been not only a satisfying task but rather a stimulating one to review the literature pertaining to ulcer of the last fifty years, not to mention that it has been instructive as well. Following our stated pattern of peaks and valleys in the Fad and Fancy of the moment, it is amusing to see one method riding herd for awhile to the almost complete exclusion and extinction of all others, provoking reams of pseudo-authoritative writings in the literature, opining that at last we are on hallowed ground, that the problem of ulcer is no more. Then those inexorable judges come into the picture, "time and experience," and one notes that the literature on the "New Way" diminishes in a continued decline and gradually but completely sinks into oblivion. Surely there must be some red faces among those authorities if they go back and read some of their cocksure enthusiasms which even they themselves have long discarded from their therapeutic armamentarium. One feels much in sympathy with old Hieronymus Cardanus who threw all his medical books out the window and announced to the world at large, including his scientific brethren, that he was henceforth practicing medicine in the light of his experience and not from written dogma.

One could be amused at the rise and fall in popularity of these "new methods" and regimens, so similar to the stock market averages or milady's fashions, were it not for the fact that the victim of these vagaries of some and downright idiocies of others is a suffering human being who without being consulted is being used as a guinea pig and who has had imposed on him willy nilly a succession of outrages; and outrages some of the suggested methods surely are. Caught invariably in the middle of a succession of controversies, he alone suffers the pain and puts up with the disability until a new wave comes along and the experience is repeated. There has been a feeling abroad everywhere in recent years that one should never criticize unless one has a constructive solution to offer. This dictum was the illegitimate offspring of political expediency, badly needed by its exponents to cover up their own malfeasance. In medicine it can never be other than helpful to ourselves and our patients if we analyze our own follies and foibles, even if the only profit from doing this is that we shall not commit them again.

As an example, it was not in any spirit of criticism that this review of the literature was made; it was truly an altruistic interest in the opinions of outstanding medical authorities on this subject and also of others not so outstanding. Then as the incredulous recommendations of these men came to the fore, there came possibly the conviction of a crusader, that if our erratic aberrations were brought face-to-face, confronted resolutely, we might all benefit thereby, patient and physician alike, the former by not having untried nostrums foisted upon him and the latter by having his eagerness to accept all too quickly any

untried theory curtailed. The author recognizes the fact that in many many cases this all too prevalent eagerness is born rather of desperation and of honest endeavor in trying to help a patient or patients.

In the literature of the past fifty years covering the etiology and treatment of peptic ulcer one finds forty-six different regimens in therapy recommended, eighty-nine different pharmaceutical preparations recommended, nineteen non-pharmaceutical preparations and fourteen etiologic theories and concepts as to cause. The very multiplicity of methods advanced for treatment is proof of the efficacy of none. Once again, to recapitulate and to apologize, the purpose of this paper is not to criticize; its only purpose is to look backward. If by looking backward we can learn enough about past perpetrated follies so as to incite in each of us a keener scrutiny into the theories advanced in our own time before they make the uninformed headlines, then we have indirectly helped countless numbers of ulcer sufferers. Having adopted a stand that it is entirely without criticism that our past follies are paraded before us but that it is done in an earnest desire to prevent these follies in the future, let us do as the statisticians do and break down the figures presented.

THEORIES OF ETIOLOGY

Mechanical. There are numerous and sundry variations of the old Cohnheim theory regarding pressure exerted on the stomach and duodenum by the left lobe of the liver pressing these organs against the vertebral column in a sort of squeeze play. The trauma so produced is supposed to cause terminal emboli and/or small hemorrhagic petechiae which ulcerate, then enlarge into true ulcers. This theory did not originate with Cohnheim. It can be found in Galen's works and, inasmuch as there is much evidence that Galen was a copyist, he may have lifted the idea from somebody else. This theory was the basis for the occupational disease etiology of ulcer and its questionably high occurrence in shoemakers. This theory was brought forth again in 1946 and 1947, refurbished scarcely any and advanced by its proponent as "new."

Infections. There could scarcely be anyone who is not familiar with Rosenow's theory of focal infection, particularly a specific streptococcus which could be obtained from dental root abscesses, sinuses, tonsils, et cetera, and which when injected into a guinea pig produced shallow, punched-out ulcers in the pylorus, lesser curvature or duodenum. Rosenow's theory carried the name "elective localization of bacteria."

Although Rosenow's theory has fallen into oblivion, we have had a newer version of it published in the *American Journal of Medical Sciences* in 1945. The title reads, "Peptic Ulcer Produced by a Specific Organism Fulfilling Koch's Postulates." There was also a proponent of a particular strain of B. Welchii as a cause. Similarly there was also a proponent of a strain of straphylococci as being causative. Laboratorily we find one man producing ulcer by the intravenous injection of strains of Staphylococcus pyogenes in rabbits. One man went so far as to advance a thrush fungus as etiologic. Off shoots of the above infectious theory have been advanced as causative, e.g., mechanical changes in the direction of lymph flow from the ileocecal area, particularly if the latter area is in a state of either irritation or inflammation, low grade or otherwise.

Constitutional Predisposition. This theory covers a multitude of angles, such as that ulcer is apt to occur more frequently in certain families and that one can chart the incidence of ulcer in these families in such a manner that heredity can be advanced as a factor in etiology of ulcer. It bulwarks the beliefs of those who believe in "ulcer diathesis." Diathesis is used to designate a presumed biologic or physiologic change in body chemistry in such manner that in any individual in which this is present it would manifest

itself in the form of an ulcer. Heredity, familial tendency and diatheses act either alone or as helpmates to each other in varying undetermined degree to bring about their materialization as peptic ulcer.

Endocrine. Here exists the opportunity for a wide play of factors. The theory of deficient thyroid activity and hypotonia—myasthenia gastrica—probably both directly and indirectly is associated or is a part of the theory of "fatigue hypotonia" or "fatigue atony" as a cause of ulcer. This covers also the tired business man and why he gets ulcers. Overactivity of the thyroid with spasm of gastric musculature, the direct opposite of deficient thyroid action is also advanced as etiologic and is presumed to produce by said spasm arteriolar emboli which break down and become necrotic. The slough leaves a small ulceration which enlarges and becomes a true ulcer. Again it covers our tired business friend. The concept of overactivity and of underactivity of both the anterior lobe or of the whole pituitary gland are advanced in exactly the same manner as in the case of thyroid etiology.

The literature did not disclose any one advancing hypo-adrenalinism as a cause of ulcer although the proponents of the hypotonic and gastric muscular atony theories certainly could or should have injected some part of the concept of hypo-adrenalinism into their theory, in my belief. Nor did any reference mention ulcer in Addison's disease. When it comes to hyperadrenalinism, however, the story is different. In here comes the theory of "The Kinetic Drive" ulcer, a disease of the Phi Beta Kappa's, of the hard driving business man, therefore, reduce his drive, excise his adrenals. How many patients had an Addison's syndrome to contend with on top of their ulcer we were never told. One wonders were there any postoperative sequelae in the form of malpractice suits. We were never told. What of the moral and intellectual integrity of individuals who, misguided and under the cloak of pseudo-authority, perpetrate the imbecilities of an arteriosclerotic upon their unsuspecting fellow men?

Nobody has had the effrontery to advance any prostatic change as the cause of peptic ulcer except indirectly. Rosenow in his theory of focal infection did call attention to it. The citation of all these theories dealing with the pathogenesis of ulcer is admittedly exhausting, but it cannot help but serve some purpose if even only to bring the reader up-to-date on medical bibliography. When one counts and finds that in the past twenty years 550 articles have been published pertaining to the etiology and pathogenesis of ulcer alone and that as a specific illustration the high peak, when estimated by years, was in 1922 when thirty-six articles appeared devoted to this one phase of ulcer alone, one gets an inkling into the enormity of the writing which has been done.

Allergy and Amebiasis. The proponents of specific protein sensitization of individuals with their histamine and anti-histamine factors playing a rôle have been able to make out a very plausible theory. The seasonal frequency of activation of acute ulcer symptoms falls indirectly into this same field of allergy and has been brought forth as another spoke in the wheel of evidence for the theory. Once again the name of Cohnheim enters the picture as he in reality first advanced this idea of seasonal recurrence.

Scattered here and there in the literature at about five-year intervals certain individuals have endeavored to tie in peptic ulcer as a part of an intestinal amebiasis and then have apparently been quite intrigued with the thesis of Amoeba histolytica acting as a causative agent.

Miscellaneous Causes. Several minor etiologies involved are venous stasis and colloidal diffusion. Theoretically, if one follows this theory in its natural course, cases of cirrhosis of the liver, passive congestion of the heart and chronic Bright's disease should feature peptic ulcer as a prominent accompanying syndrome, but clinical experience does not corroborate this.

Relative to trauma, other than Curling's ulcer of the duodenum following severe burns, the mechanics of the production of which are quite foggy I believe, it would be difficult to find many men willing to agree upon direct trauma as an instrument in the production of ulcer.

In the case of tuberculosis the proponents are confusing the issue and talking of a tuberculous ulcer of the stomach. On direct questioning of present day leaders in gastrointestinal work, none has ever seen and most pathologists readily admit that they, too, have never seen one.

Improper eating habits, excessive smoking and alcohol are mentioned occasionally. Such factors as the hurried bolting of food, the eating of foods either too hot or too cold, overindulgence in highly seasoned and highly spiced foods should, in the light of our present day knowledge, be considered in the light of contributory rather than as directly causative. In the same category we would place smoking. Clinically, it is unusual to find heavy drinking and ulcer associated, possibly because, does alcohol not have a more hardening or tanning action?

Neurogenic. Under neurogenic etiology it is not out of order to include two subclassifications, not in any manner depreciating them into minor as they are major. In the *psychic* type we have the neuroses, neurasthenia, hypochondria, post-traumatic neurosis, hysteria and psychosomatic problems. The sympathetic or autonomic type of etiology is based mainly on a concept of vagotonia as productive of ulcer. This was aided and abetted by the discovery in the laboratory animal that electric irritation of the vagus nerve can be caused to produce an ulcer.

It is customary when speaking of the part played by the nervous system in ulcer production to stress the anxiety neurosis based on fear, emotional distress, et al. The psychosomatic group have apparently appropriated this field and therefore a discussion of it falls more naturally under that head. Suffice it to say that vasomotor disturbances in these anxiety neuroses manifest themselves as palpitation, vertigo, dizziness, dyspnea, diarrhea and epigastric distress. Neurasthenia is an old timer as terms go, high lighted by and in the days of Wier Mitchell. It is rather a vague term and has always been used in rather an elastic manner to cover a varied symptom complex. These patients have certain things in common in addition to their epigastric distress and ulcer simulating symptoms. Common to almost all are a low threshold of adaptability to the realities of life, a high degree of emotional instability, extraordinary and unaccounted for fatigue and either a fairly true migraine syndrome or a pressure band around the head.

There have been attempts by some to name hypochondria as a causative agent in production of ulcer. This is entirely in error. It is true that hypochondriacs do have ulcers—coincidence purely—and it may be true that an ulcer makes a hypochondriac of an individual. It is very necessary that we evaluate properly all neurogenic influences associated with ulcer and assign to each its proper place. In the future we are going to see more and more of these patients as they drift away from the care of the Veteran's Administration. Hypochondria is truly neurosis-somatic in type. The individual pattern of conduct, whether male or female, is that of a transference of attention to the stomach, an intense pre-occupation with some bodily organ—in this instance the stomach—although minute detailed study will reveal no pathologic deviation from the normal in even the slightest degree. A hypochondriac's interest, instead of being centered externally upon the world around him and adjusting himself to it, becomes centered in himself and in his body. His complaints are subjective. As these intensify because he does not seem to find relief, a certain amount of psychic elaboration takes place and he becomes a very sick man. In my opinion the best approach to treating this individual is to

go along with him, agree with him that to all intents and purposes he had an ulcer, distract his attention from his ailment to his dietary regimentation and his hourly schedule of medication with occasional assurances that progress is definitely being made.

We can dispose of the post-traumatic neurosis as an etiologic factor in production of ulcer by saying nobody has offered the slightest evidence warranting such an assumption. If ulcer occurs in such an individual, it is by sheer coincidence. He or she who develops an ulcer after trauma, severe or otherwise, must have other factors contributing to such production. Possibly the psychic conflict with regression and failure at adjustment or restitution of one self into society may contribute indirectly to whatever biochemical, physico-physiologic unbalance is necessary.

Hysteria is definitely not etiologic. It is merely a psychic disturbance which can manifest itself by simulating any sign or symptom of organic disease. These states are an aftermath of war and it will be our experience to run across not a few but many.

More recently a psychosomatic theory has been evolved as to an etiologic factor in ulcer. I do not consider myself as competent to judge here. I can only illustrate my attitude by the following experience.

About twenty years ago it was quite the mode for our psychiatrists and psychologists to go to Vienna for experience at the fountain head of certain branches of their science. Invariably these men became involved in mental and extramental problems and separations of former well meaning husbands and wives took on epidemic proportions. Not long ago I attended a seminer on the psychosomatic approach to ulcer. As the session was closing several men asked me for my opinion. It was easy to give: If you believe whole heartedly in what you have heard, your handling of an ulcer case becomes almost unbelievably easy. You simply tell your patient, they must either chuck their job or chuck their wife or husband as the case might be. It would be amusing to watch somebody else handle ulcer cases in this manner and to see how long they had patients coming to them for such handling.

At the last meeting of the A. M. A. in Atlantic City, toward the end of a session when discussion was thrown open to the assembly at large, a doctor indicated that he would like to speak. There was much noise as scores were leaving their seats. Finally, the individual launched into an exposition of his own ideas, namely, that if people lived and upheld the Ten Commandments there would be no need for vagotomies, partial or subtotal resection and what have you. The applause was more than any other speaker had received.

I do not want to leave this subject of etiology of ulcer without at least referring to Harvey Cushing's observation that he thought there might be some thalamus or hypothalamus association in etiology. Inasmuch as our information as to the physiology and function of these brain areas is meager, nothing is to be gained attempting to discuss it.

THERAPY

The patient has suffered both directly and indirectly as the result of prejudice and lack of knowledge as to etiology; but when we delve into the realm of therapy, the patient has truly experienced hardship, misfortune and insult.

Not long ago A. C. Ivy estimated that in any ten-year period of life in America it could be counted on that one and a half million people would develop ulcer. If each of these patients is to experience hardship because of variances in opinion as to therapy, honest though they may be, the sum total of trauma to be expected is truly awesome.

A count of all the methods of treatment proposed for ulcer since 1900 shows forty-six different procedures. In 1947 a new

treatment was reported for ulcer sufferers. The patients could eat good nourishing food instead of "baby foods" provided they took a combination of mucin and aluminum magnesium trisilicate in palatable form. How many recall "mucin therapy" when patients esthetic sensibilities were violated but they took the stuff because they wanted to get rid of their pain.

Another recommended agent, new, right hot off the griddle, composed of "insoluble alkalies." They do not tell you which ones because after all its new. We have not been talking about insoluble alkalies much more then fifteen years. Why does it act better than anything else ever promulgated? Because the fellow who got this one up, got to "thinking," yes, sir, actually "thinking" and he came up with the answer: This product controlled the acid in the duodenum—yes sir.

Another one is colloidal aluminum hydroxide and magnesium tri-silicate. There are fourteen more like it but each has a different name; all unanimously set out to produce one thing above all others, palatability to the patient.

Intramuscular injections of protein free pepsin, daily for ten days and three series of ten injections each, have been advocated. The advocates of histaminase therapy based their work on histaminase neutralizing histamine action thereby lowering the gastric acidity. If there was an allergic basis for ulcer, histaminase here again neutralized the action of histamine, the basis factor involved.

In another authoritatively written article the "acid-pepsin" factor in gastric and duodenal ulcer is emphasized. It goes on to say that 75 per cent of all patients with gastric ulcer and 20 per cent of those with duodenal ulcer have low or normal acid values in the stomach while many people who show high acid secretory curves have no subjective or objective evidence of ulcer. The article stresses the continuous neutralization of acid particularly at night wherein it is said the Sippy and other regimens take no cognizance of the presence of highly concentrated acid in the stomach at night. It is recommended that the patient empty his own stomach before retiring. Much depends on the patients being able to acquire a "tube technic" as the intubation is more or less left entirely in his hands. These authors must have had unusually cooperative patients whose esthetic threshold was low. Otherwise how could they perform functions all day and night with a tube hanging out their mouths as recommended.

We have many types of "gels," aluminum phosphate gel being most popular or aluminum hydroxide with ingredients added here and there, usually non-absorbable antacids to augment or counteract certain features of their action.

Many an observer in this particular field of gastroenterology has tried to establish a certain facies and physiognomy as typical of the ulcer patient. I quote from a description: "Ulcer occurs in thin, high strung, lantern jawed persons who work hard, worry excessively, and are introspective." Peculiarly enough during a respectable span of years in this field I have never come across the lantern jaw with an ulcer. Possibly mere coincidence and I have been avoided by the lantern jawed, but you can get as many different descriptions of the presumably facial contour of these patients as you have time to dig up the literature. This theory or supposed theory went into total eclipse some years ago.

The curious phenomenon of all the advocated therapies for ulcer is that one individual will advocate one theory and another individual advocates the direct opposite as producing exactly the same effect. The injections of protein free pepsin as fostering healing with cessation of symptoms is advocated in one article, but in another article the author advocates using anti-pepsin injections and wants to go on record as obtaining the best results.

To return only briefly to the advocacy of a physiognomical type as particularly susceptible to peptic ulcer, another group of observers stress the hereditary and

familial occurrence of ulcer or, as they express it, the heredo-familial tendency to ulcer. In enlarging they offer an "ulcer personality"—"a restless, aggressive individual, possessed of great excitability and enthusiasm, involved in one emotional cause after another, dependent on the success or failure of his 'drives' in the field of economics, love and living.

Some years ago the writer published an article on the possible rôle of the thyroid in peptic ulcer, endeavoring to find but with little success a scientific basis for that which we untuitively sensed. Since then and before we have had numerous ductless gland products administered to ulcer patients with reports of successs in healing. There have been pituitary extracts—anterior, posterior and whole gland. One attributes ulcer to a parathyroid deficiency and advocates replacement therapy, e.g., liver in pernicious anemia, thyroid in myxedema, etc. One reports having given 1 cc. of parathyroid extract injections at varying intervals and mentions sixteen years of success.

A Naval Medical Bulletin publishes an article in which desoxycorticosterone injections were given but concominantly the patient was placed in bed on a Sippy regimen. Instead of crediting the Sippy regimen with some influence in the disappearance of the ulcer crater, through some process of reasoning the author prefers to credit the desoxycorticosterone. Only a few years ago one man was reporting bilateral adrenalectomy as a cure.

Three authors used posterior pituitary extract; 15 to 30 units (international) of pituitrin was given daily in divided doses for seven to fourteen days based entirely on an observation that a moderate polyuria and nocturia had been observed in cases of peptic ulcer and that the mechanism involved might be the same as in diabetes insipidus; therefore, posterior pituitary extract was indicated. There is no questioning as to whether this polyuria, which is recorded in the report as mild, might not have been due to whatever regimen the patient was following prior to pituitary therapy. This previous regimen might have had a high liquid content in the form of milk alone. In addition there was no questioning as to whether the patient was taking alkalies and what type of such, as alkalies often cause a frequency and polyuria; there was no checking or rechecking but a rush into print with results in seven cases. This was followed two years later with experiences in forty-two cases. In this latter report the original therapy was augmented by nasal insufflation of posterior pituitary extract and this was advocated as a "New Method."

A very well known gastro-enterologist discussing sex hormones and peptic ulcer observes that pregnancy has a beneficial effect upon ulcer because symptoms of ulcer are exceptionally rare during pregnancy in his experience, and in addition that the symptoms of ulcer in women tend to be aggravated during the menopausal period. Assuming these facts to have some involvement or relationship to a pituitary-gonad-thyroid mechanism, this observer gave to an equal number of men and women with ulcer fourteen daily injections of antuitrin S either subcutaneously or intramuscularly and then tabulates his results, arriving at a conclusion that 61 per cent of his patients were symptom-free at the end of fourteen days. Gastric analysis during and after treatment showed no effect on either the free or total acid secretion. The conclusion finally arrived at is that the urine from normal persons contains a protective factor against ulcer formation in rats and that in the urine of patients having ulcer this factor is absent.

However, if one reviews a considerable amount of the literature on this subject of ulcer, and presumably the same applies to almost any medical or scientific entity, one cannot help being struck with the repeatedly same pattern of thinking. It follows definitely Pavlov's theory of the conditional reflex in its sameness of pattern although there may be long intervals between individual pronouncements.

Remembering how Pavlov trained his white mice so that at a sound, with a definite pitch not one iota above or below, the mouse started for his dinner, this same conditioned reflex can be transposed into human conduct, specifically in the entity we are discussing. Over and over again we meet with repetitive conduct, reasoning and advocacy in the treatment of ulcer.

A gastro-enterologist of wide experience noted the rarity of peptic ulcer and also the extreme rarity of acute perforation in females as experienced or demonstrated by his hospital records. This fact corresponds to the initial idea from which he deduced that the ovary or testicle might secrete some protective material against ulcer, therefore, he gave ovarian extract to his females with ulcer and, transposing this analogy into male, gave them testicular extract, whereupon he immediately published a paper announcing success for his brainchild.

The above has been rather a boring résumé of the highlights only in the hormonal or endocrine approach to the ulcer problem both from the etiologic and therapeutic standpoint.

Exactly the same type of conduct and experience prevails in the field of vitamins. Every vitamin known has been advocated as a palliative or cure for ulcer on the basis usually that there exists in the individual having ulcer a definite deficiency of that particular vitamin. After some years of trial and error the fallacies of these types of thinking glare fearfully in their barrenness and a bit red-faced the profession drops them quietly into the limbo where they belong. With no other objective than that the record shall be more or less complete, mention and mention only will be made of other methods of therapy which for one reason or another have occupied the center of the stage for an interval of time. It was with a great deal of surprise that on a recent program of a national medical society one heard a foreign clinician, whose name is known to any American in this same field, discuss, apparently in all sincerity, the benefits of deep x-ray therapy in peptic ulcer, an idea which time and experience have exploded as a complete fallacy. It is recalled that years ago this same individual handed a bag of calcium carbonate to every patient in his clinic whose condition was diagnosed as ulcer, and very frequently the diagnosis was not corroborated by x-ray. The patient was told to carry it always in his pocket and that whenever he felt any epigastric distress he was to take "about" a teaspoonful or take the same amount every two hours. If the clinician's present advocacy of roentgen treatment has been arrived at in a similar slipshod manner as his therapy of former years, why is such an individual even allowed to air his opinions before an organization of presumed sound scientific and medical integrity? Since starting to write this paper, the roentgen therapy of ulcer is again being recommended, this time from an American clinic.

At another very august meeting of a very august society one of its members promulgated the use of histamine injections as of therapeutic value on the basis that, although histamine did provoke high acid values, it had the faculty of opening up constricted vessels in the body, therefore in the stomach. No mention is made as to whether or not this same faculty or property (the latter word is more pertinent) could not contribute to possibility of hemorrhage from an ulcer.

Another learned scientist, a laboratory biologist not a physician, is able by his pet theory to blame the suprarenals for gastric ulcer and the thyroid for duodenal ulcer. His theory involves an excess of iodine in the body which, when already high, is further augmented under emotional stress by iodine released from the midbrain, a powerful storehouse of iodine, and from the pituitary, parathyroid and thyroid glands. Excessive amounts of iodine and chlorine may cause a breakdown of the gastric mucosa and lead to ulcer

formation. Mention must be made of the use of ingested antiseptics as a method of treatment. Usually these antiseptics were of the dye family—metaphen, merthiolate, forms of violet dyes. Their use was based on the fact that they overcame peri-ulcerous infection which was presumed without proof to be always present. They are mentioned only in a historical attitude as they were a fad of but only a moment. Scarlet red, another dye, once recommended should not be omitted. In similar manner must one refer to the injection of sodium citrate solution intravenously and also of hypertonic salt solution.

At the present time we have new actors hogging the stage, two medical and one surgical. Unfortunately for the medical agents, who arise from well accepted and orthodox sources of unquestioned integrity, they first hit public attention by way of lay channels, namely, the non-medical press. Ulcer patients by the score approached their physicians with copies of these newspapers and periodicals with the query—"Do you know about this? Why am I not getting it if it will cure ulcers like it says here"?

I refer to the recently announced theories: (1) split proteids orally in large amounts and (2) enterogastrone. One daily newspaper noted for its conservative approach to all things makes the announcement of enterogastrone thusly and I quote from a clipping: "A hormone extracted from the intestines of newly killed hogs has *proved helpful* in curing peptic ulcers of human beings by injection into the muscles." Here again comes that constantly recurring paradox to the fore. Enterogastrone was first isolated in the laboratory of Dr. A. C. Ivy some years ago. I recall at the time writing to Dr. Ivy and his letter of reply was conservative and orthodox-ethical, but note the manner in which the press gave it out.

When we speak of a paradox with reference to enterogastrone, it is for the reason that entergastrone is probably a chalone or an inhibitory antacoid, whose function is to inhibit gastric motility and secretion, whereas mention has been made of the advocacy by some of injections of histamine substances in the therapy of ulcer. As a by-product of Ivy's enterogastrone investigations we have an explanation of a phenomenon which we had all observed in ulcer cases, namely, that a high fat intake reduced gastric motility. Ivy demonstrated that when undigested fats come into contact with the fat sensitive portions of the upper intestinal tract, an excess of enterogastrone is excreted and its inhibitory action on gastric motility and secretion takes effect. The fat itself has no inhibitory powers; it initiates a demand for increased secretion of enterogastrone. More recently we have had much about urogastrone thrust upon us.

Up to the moment we have dealt mainly with the fads and fancies of the medical approach to the ulcer problem. The surgical approach also had and is having today some of its own folderol falling into controversy and not emerging too cleanly washed of some of its sins. The first operation for ulcer came into being as the result of sheer necessity and had the good fortune to meet up with a personality possessing sufficient ingenuity and daring to formulate a plan and act on it. The first gastro-enterostomy was done in Vienna at Billroth's clinic by an assistant named Wolfler.

These initial gastro-enterostomies were done not particularly with anything in mind toward healing an ulcer but mainly to relieve an accompanying pyloric obstruction. Indirectly it was hoped and later staunchly advocated that by keeping the ulcer area free from contact with the food column an optimum condition for healing was obtained and that, therefore, the ulcers did heal.

As might be expected following such an announcement, there was a violent wave of doing gastro-enterostomies all over the world and in similar manner all over the United States. The operation was not too difficult; the technic was easily mastered

and the mortality rate even in questionable hands was not too high. What was lacking was proper selection of those who did not do well following gastro-enterostomy, and laying down a formula by which one might be able to prognosticate which individual was a probable candidate for a quick recurrence of his ulcer and which not. Experience was that elderly people fared best with gastro-enterostomy both from the standpoints of mortality and recurrence. Young people did not fare so well as regards recurrence, and here we must use that phrase which is hackneyed, particularly the hyperkinetic type.

In no time at all after posterior gastro-enterostomy took its place in the armamentarium of the abdominal surgeon the technic of anterior gastro-enterostomy came flashing over the surgical world and many were the advantages initially claimed for it.

Time and experience evaluate all these things coldly and soon their value finds its proper level in the scheme of things. Some surgeons prior to gastro-enterostomies had made attempts at local excision of ulcers with rather indifferent results so that it was almost inevitable that there should exist a sort of psychic barrier to merely by-passing an ulcer without any direct attack on the ulcer itself. Therefore, the next step in the evolution of the surgical approach was local excision coupled with gastro-enterostomy, usually posterior.

Following this came a wave of attention directed toward the pylorus. On the surface it would appear that any surgeon of any prominence originated some type of plastic operation on the pylorus. Almost all these technics were designed to facilitate easier emptying of the stomach.

At about the same time a wave of exclusion operations was born, Eiselsberg, Devine, et al. In this wave a duodenal ulcer was or was not resected according to ease and operative risk. Between a double row of sutures across the pylorus complete separation was made by cutting the ends folded in by serosa to serosa suture on the gastric side and the pyloric side. In such manner it was made certain that food could not possibly get to the ulcer area as it was doing in so many gastro-enterostomies in which food continued in its old way of passing out of the stomach by way of the pyloric canal into the duodenum instead of passing through the new stoma.

A so-called "gastro-enterostomy disease" which was plaguing surgeons also appeared. It was the result of a vicious cycle wherein food would play around that portion of loop between the new stoma and pylorus. Often antiperistalsis came into play and food would pass up and down this loop, regurgitate into the stomach then through the stoma back into the stomach and pass out again through the pylorus, a very regrettable state of affairs particularly to the surgeon involved. To try to correct such a state of affairs was the reason for the birth of all the exclusion types of operative procedure. They created a blind end at the duodenum; food could go no farther and there was only one exit from the stomach, not by way of the pylorus but via the new stoma the gastro-enterostomy had created. While all this was going on, many men dissatisfied with their results with gastro-enterostomy were playing with the idea of resections of the stomach sometimes including the ulcer when it was feasible, but these procedures were applicable only to gastric ulcers and then only if the ulcer by chance was in a particularly accessible area anatomically and surgically.

In 1896 came Billroth's pronounciamento of his Billroth I and Billroth II type of gastric resection. This was a milestone in the history of gastric surgery in spite of the fact that there are detractors who claim that Billroth was not the actual originator of these procedures, that he has seen them done by somebody else, that he adapted them as his own and that he was in a position to shift all credit and publicity to himself.

The difficulty with the anastomotic

types of operation was that they did nothing to reduce gastric hyperacidity and hypersecretion, particularly night secretion. These Billroth procedures filled the gap because they featured and emphasized the taking away of all or almost all of the acid-secreting portion of the stomach.

On the heels of this a flood of modifications of the original technic came almost immediately. More or less only two have survived, the Hofmeister-Finsterer technic and the Polya, whole-width anastomosis of stomach with jejunum.

The many plastic procedures in addition to the multiple tricky resection modifications have died unsung and unheralded. What has survived has done so because of some measure of human value over the years.

For approximately the next forty years the surgical pot simmered slowly with little or nothing happening to disturb its equilibrium. Meanwhile, the medical men announced another fallacy, namely, the treatment of peptic ulcer by means of rectal instillation of sugar solution. The surgeons announced opposition to any such extensive procedures as subtotal gastrectomy with its high mortality for such a "simple" thing as an ulcer, but total gastrectomy for that ulcer high up on the lesser curvature was a different matter and was O.K. A few even recommended going back to an old procedure which existed prior to gastro-enterostomy, local cauterization of the ulcer. Another advocated a dorsolumbar sympathectomy based on Cole's work with the sympathetic of this area.

Duodenectomy, pylorectomy, fundusectomy and oblique gastroduodenostomy all came into the lights, took a bow and then went back stage into darkness.

The wave of popularity and enthusiasm for gastric resection particularly in Europe supplied abundant material for histologic study. Based on this tissue study, out of France and Germany was born the theory that a gastritis, hypertrophic or ulcerating in type, was the forerunner or underlying factor in the pathogenesis of ulcer and that on this basis its chronic course and its remissions and exacerbations could be explained; they denied the importance of the pepsin-hydrochloric acid factor in ulcer.

About twenty years ago Eppinger in Vienna suggested that vagotonia provoked spasms of the muscularis and of the muscularis mucosa, leading to areas of ischemia which favored formation of erosions and ulcers. A spastic condition operating on the end vessels in these two layers was a possible predisposing cause. This lead to endless experiments on the vagus nerve and on extirpation of the sympathetic and celiac plexuses; but in the laboratory the results of these experiments were entirely too contradictory and, therefore, the theory was laid to rest. Now it has been brought forth anew, polished up and occupies the center of the stage this year (1948). Also along in the early 1920's the vagus nerve was occupying the attention of various laboratories throughout the United States. From some laboratories came reports that stimulation of the vagus nerve could be made to initiate ulcer lesions in the laboratory animal; from other laboratories came word that section of the vagus, anterior and posterior would cause ulcerous lesions in animals—again the oft repeated formula of "paradox."

Here and there, particularly in cases of gastric ulcer high up in the stomach where the operator was working in almost the immediate vicinity, an occasional section of the vagus nerve was done. At times it was only the anterior portion of the nerve which was cut due to accessibility; then some men wanting to satisfy themselves better as to what could be accomplished sectioned both the anterior and posterior branches.

However, it was not until the past two or three years that, due primarily to the lay press featuring the dramatics of any situation, the message has been taken to the lay public that here is the "miracle operation" so long awaited, here is the last

word on ulcer; there need be no more suffering; this is it. So once again the ulcer patient in the rôle of a cash customer gets on the ferris-wheel to be lifted to dizzy heights of expectation and then the wheel turns downward and he is on the ground again, a soberer individual, feeling that all is not exactly as it should be, that maybe he has been taken. The press goes on and repeats this performance over and over. Memories are short. Nobody seems even to remember the part played by this "miracle operation," but the doctor and the medical profession get an extremely large and very deeply discolored eye.

One of the functions of the vagus nerve which arises from central nuclei in the brain stem is the conveyance of the sensation of pain from several organs in the upper abdominal tract, specifically the stomach and duodenum, to the brain. The pain experienced by the ulcer patient when there is activity or irritation about his ulcer or when the raw base is bathed in a concentration of hydrochloric acid or mechanically irritated by food brushing over it is at times frightfully severe. One of the almost consistent advantages claimed for vagotomy, the miracle operation, is that it immediately gives the patient relief from pain. There is room for argument here as to whether or not relief of pain *per se* is a most desirable thing if the underlying factors involved in the production of pain are not taken care of. True it is not an identical analogy. But is the relief of pain in angina pectoris by way of sympathectomy entirely a desirable situation? Evaluating human conduct and its aberations with a cold jaundiced eye, freedom from pain sensation could more often than not create a false psychic euphoria, and patients are more likely to overstep their dietary limitations with more or less disastrous results to their ulcer condition. It occurs that it would be of interest to observe in patients who have had vagotomy whether there is any higher tendency toward postoperative hemorrhage or perforation, and by postoperative is meant not immediately but some time after operation.

There has been a tendency to overlook entirely the fact that the vagus nerve plays a part in pancreatic function, in liver function and in upper colon kinetosis. To date no work has appeared in medical journals with regard to postoperative upsets in carbohydrate or fat metabolism following vagotomy. One or two papers have remarked as to the disagreeable feature of epigastric and upper abdominal fullness due to the protracted delay in emptying time of the stomach because the propulsion or peristaltic muscular contractions have been interfered with by upsetting the normal physiologic rhythm through sectioning the vagi.

In all of nature there is an interlocking or integration of physiologic processes, and no work has as yet come forth to show that the stimulus in the mid-brain comes from food intake, sham or otherwise, that it is transmitted by way of the vagus nerve to the secretory mechanism of the stomach calling for just so much and no more of pepsin and hydrochloric acid and that this brought about a stage of digestion which at a certain point causes the pyloric sphincter to relax and the food to pass into the duodenum. Even Pavlov in all his digestive experiments was unable to answer both the quantitative and qualitative riddle of this outpouring of digestive juice, particularly what controlled its selectivity or what directing mechanism controlled the pouring forth of large amounts of pleasurable juices to take care of a thick steak and such small amounts to moisten only a teaspoon of sand. Such is the economy of nature and the physiologic integration of our processes of living.

It comes out now that in cases in which vagotomy has been done some men are having trouble with an atony and dilatation of the upper colon, an idiopathic dilatation of the colon with its bloating, distention, fullness and discomfort. So the patient has swapped his pain, which told him to take a glass of milk with or without

some alkali, for an uncomfortable readjustment of his belt. The vagus nerve being cut, no pain sensation is transmitted to his brain but he can look down and see a pregnancy-like ballooning of his abdomen and he does not like it.

Some measure of relief in the above can be expected possibly by combining vagotomy with gastro-enterostomy. This would provide a mechanical exit of varying degree of function, but would do nothing toward the digestive process to reach the point where active propulsive peristalsis would push the food out of the stomach.

Due to the lowered acid secretion in the stomach following vagotomy persistent diarrhea has been a complication in a number of cases. True, some have cleared up after a time and without medication, but others have been protracted and troublesome. What irony if only the administration of free hydrochloric acid will relieve this diarrhea in a patient who formerly manufactured his own free hydrochloric acid and who after an operation to obliterate his capacity to do so finds that he must take synthetic hydrochloric acid to relieve the very symptom he substituted for that of his ulcer.

De Muth, of Vancouver, makes a very pertinent and timely point with regard to postoperative disadvantages of vagotomy. At this very moment wherever one chooses to look—street cars, bill boards, store counters—one sees the admonition, "One in eight will die of cancer." If one gets the daylights scared out of them, they will pick up a leaflet and the leaflet tells them that at any sign of pain or discomfort they should see their doctor. The vagotomized patient will be unable to do this as far as his stomach is concerned because he is free of the sensation of pain from the region of his stomach, and he will not know whether anything is going on or not. If he develops a new ulcer, a carcinomatous change in his former ulcer area or an actual carcinoma, he will go blissfully along completely unaware that all is not well within. When other signs or symptoms do come along warning him or the physician, it stands to reason that it is probably "later than you think."

De Muth also warns that vagotomy is so permanent. Unlike some operations on the stomach it cannot be undone. What price this, if later it should prove from experience that it, too, was but the star of the moment in the play of fad and fancy. The question which will come up sooner or later before the bar of sound medical opinion will be, Is vagotomy a miracle or is it a disaster?

At one of our recent national medical conventions a great surgeon told his audience of medical men that two of the great faults of medicine, among others, were prejudice and lack of knowledge. In his opinion the latter was very evident in what we were doing about vagotomy. In his words, "vagotomy is a very desirable thing if it has no price." There is entirely too great a depth to the wave of enthusiasm for vagotomy; it was the same in the beginning of gastro-enterostomy and gastrectomy. The late or end effects of vagotomy on the histology and physiology of the adrenals, kidney, hormonal system have as yet not been evaluated. The surgical handling of the problems of hemorrhage and perforation following vagotomy are entirely without the scope of this paper.

Keenly aware that what is an absurdity and to be laughed at for the people of one era may become the scientifically proved dogma of a later generation, and grasping at the reasonable assumption that all men in the field of medicine are concerned only with the betterment of their fellow man, it is reasonable to assume that men of much more than average intelligence should advocate only that which they would choose for themselves as offering the most good and by this criterion should all therapies of ulcer be judged.

A natural query would be as to what might be one's own personal approach to the ulcer problem. It would be as follows: "Exhaust every method and avenue of non-operative approach and, if operation

is inevitable, avoid the procedure of unknown consequences."

I am reminded again of the discussor at Atlantic City, who advocated adherence to the Ten Commandments as obviating the need for resections and vagotomies.

Long centuries before Christ, there existed an old Chinese philosopher, Lao Tze, who in philosophizing, incidentally as a side line, founded a religion. It seems these old philosophers were much taken up with a contemplation and scrutiny of the navel. Quiet, uninterrupted contemplation of this area stimulated profound thoughts and Lao came up with this one. Man was unhappy because all his life he did things which were distasteful and in reality unnecessary. Man should apply himself diligently to doing only that which he would like to do.

Inasmuch as we started this paper with the southern gastro-enterologist's offering of Teaxs bear grease, we can close with the very latest "hot off the griddle" pronounciamentos. If you have an ulcer, do not look any further; the reason you have an ulcer is because you are mental. You either fought with your mother when you were a youngster, or your father for that matter. You did not mature, that is psychoanalytically speaking, and you did not have the amount of parental affection you should have had bestowed on you.

To those who are smugly smiling because they have no ulcers, beware, for all you know you may be handing an ulcer to your son or your grandson, particularly if your life at home is peppery and irritable. Do not argue with your wife about that new fur coat. If Johnny is around he will get an ulcer sure. Give your wife that coat; it may be cheaper in the end.

If you have children, be careful, very careful. Do not love them too much; do not speak cross to them; do not beat them and do not try pushing them around. If you do not get an ulcer, they will; and if they do not, their children will, and those are your grandchildren. They will run around pushing a finger of scorn at you saying, "That's my grand-daddy and he gave me ulcers."

NEW PREGNANCY TEST

USE OF THREE INJECTIONS OF ESTRONE IN OIL*

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MUCH effort has been expended in attempting to devise an acceptable test for early pregnancy. The many technics that have been suggested for such a test bear witness that none so far have proved entirely satisfactory.

Without attempting to make a complete listing, several of the most interesting pregnancy tests may be mentioned. Among the best known are those involving injection of blood or urine from the patient into a laboratory animal, such as a rat or mouse (Aschheim-Zondek)[1] or rabbit (Friedman).[2] In interpretation of this test certain vascular and other changes in the reproductive system found at autopsy are interpreted as being positive for pregnancy. Frogs and toads are also used and the appearance of ovulation (Weisman and Coates)[3] or of spermatozoa in the urine (Galli-Mainini)[4] is presumed to indicate a positive test.

These technics require that a blood or urine specimen from the patient be sent to a laboratory equipped to handle live animals. Here the cost of the animals, their care and the salary of a well trained technician to interpret the results make these pregnancy tests rather expensive. Also, during the war it was the author's experience that the accuracy of the tests as performed by commercial laboratories deteriorated to such a low point that they were of little clinical value.

In another type of pregnancy test the patient is given injections of neostigmine methylsulfate, one each day for three days.[5] Appearance of menstruation is said to demonstrate the absence of pregnancy. Although this test has some enthusiastic users, Winkelstein[6] points out that there is danger of producing abortion with use of this drug. The chance that this will occur is probably slight.

Gediz[7] has suggested an interesting pregnancy test using corpus luteum. According to this author, a patient with overdue menstruation, given proluton 10 mg. each day for five doses, will menstruate within five to seven days if she is not pregnant. The worst drawback to this test, as the author points out, is the cost of the drug. I have had no experience with the Gediz test, which was called to my attention by Hartman,[8] and so far I have not seen it mentioned in any American publication.

The new pregnancy test that I have devised was suggested by results obtained in treatment of amenorrhea with estrone, begun when this drug was first introduced. The test has been used with slightly varying technic on some 250 patients without a single incorrect result. It consists of an intramuscular injection of three doses of estrone in oil, 1 mg. each, over a period of five days in certain selected patients. Failure to menstruate within twenty-four hours after the last injection is interpreted as a positive test for pregnancy.

This test is inexpensive and simple to perform in the office without the aid of an outside laboratory. Equally important is that in the eyes of the patient the answer which she herself brings is more impressive to her than the typed line on a card from a distant laboratory. The result is sometimes obtained within a few hours,

* The estrone in oil which was used in this study, 1.0 mg. per cc., was furnished by Eli Lilly & Company.

always within six days unless the physician, to suit his convenience, extends it to seven days.

That the test has proved completely accurate in the author's hands is probably due to accidental good fortune. Many failures will undoubtedly occur although the percentage of accuracy should be high.

Subjects Suitable for Test. To be a suitable subject for this test the patient should fulfill the following conditions: (1) She must have a history of reasonably regular menstrual periods. (2) Her menstrual period must be overdue. (There must be no vaginal bleeding.) (3) She must be of fairly healthy appearance with no marked anemia to be noted on inspection of the tongue. (4) She must present reasonably normal findings at pelvic examination although she may have signs suggesting pregnancy. (5) She must not have had any recent endocrine treatment. (Thyroid is a possible exception.)

It is found that practically all patients requesting an early diagnosis as to pregnancy will satisfy the aforementioned requirements. Only one young woman who requested diagnosis during the period covered by the fifty cases presented herein was considered unsuitable for the test (she was anemic) if one excepts patients who were bleeding.

There is a temptation to try the test on the patient whose menses have been overdue for some days or weeks and who comes to a physician with a slight bloody discharge. This should not be done with any hope of success.

TECHNIC

On the patient's first visit to the office a history is taken and a physical examination, including pelvic examination, is made. If she satisfies the five conditions previously stated, she is considered suitable for the test which is administered as follows:

1. One mg. estrone in oil is injected deep into a deltoid muscle.

2. Either forty-eight or seventy-two (approximately) hours later a similar injection is made into the other deltoid.

3. Approximately 120 hours (five days) after the first injection, an injection of 1 mg. estrone in oil is administered into the deltoid which was first used.

Alternate Method. If calculations show that the third injection cannot be made five days after the first injection, (for instance if this day falls on a Sunday) the second injection is made seventy-two hours after the first and the third injection is made six days after the first.

It will be noted that if the physician keeps office hours every day except Sunday the test may be started on any day of the week. Of course, if menstruation intervenes at any time, a diagnosis of not pregnant is made and the test is discontinued.

Interpretation of Test. If a vaginal flow of blood begins within twenty-four hours after the third estrone injection and lasts twenty-four hours or more, the patient is presumed to be not pregnant. If the patient fails to have such a vaginal flow, she is presumed to be pregnant.

In my experience there has been no difficulty in making this interpretation. The patient either has what appears to be a fairly normal menstrual period or she does not flow at all.

PRESENTATION OF PATIENTS

Table 1 shows the results in fifty patients receiving the test described herein. The first eighteen cases, although not consecutive, were selected only because complete data was available on them. The last thirty-two cases are consecutive cases of women who completed the test.

The table given here represents in a private obstetrical practice the average run of patients who come seeking a diagnosis as to pregnancy. As indicated the ages varied from fifteen to forty-six years, twenty-five and six tenths years being the average and twenty-three the median. The menses were overdue from three to

TABLE I

Case Nos.	Age	Previous Pregnancies	Days—Menstrual Period Overdue	Impression from History and Pelvic Examination Pregnant?	No. of Injections Given	Flow Began after First Injection	Flow Began after Second Injection	Flow Began after Third Injection	Flow Began Hours after Start of Test	Diagnosis from Test—Pregnant?	Final Diagnosis from Follow-up Pregnant?
1	28	2	5	No	2	o	+	..	25½	No	No
2	28	1	5	No	1	o	+	..	61½	No	No
3	25	o	8	Yes	3	o	o	+	134	No	No
4	29	2	4	No	1	+	..	..	19	No	No
5	30	1	12	Yes	2	o	+	..	62	No	No
6	20	o	11	Yes	3	o	o	o	.....	Yes	Yes
7	15	o	32	Yes	3	o	o	o	.....	Yes	Yes
8	28	o	3	No	1	+	..	..	1½	No	No
9	20	o	12	Yes	3	o	o	o	.....	Yes	Yes
10	22	o	12	Yes	3	o	o	o	.....	Yes	Yes
11	20	o	3	Yes	3	o	o	o	.....	Yes	Yes
12	31	2	3	No	2	o	+	..	60½	No	No
13	22	o	15	Yes	3	o	o	o	.....	Yes	Yes
14	24	o	10	Yes	3	o	o	o	.....	Yes	Yes
15	23	o	5	Yes	3	o	o	o	.....	Yes	Yes
16	22	1	6	No	1	+	..	..	18	No	No
17	46	5	36	No	1	+	..	..	26	No	No
18	23	1	4	No	3	o	o	o	.....	Yes	Yes
19	20	o	12	Yes	3	o	o	o	.....	Yes	Yes
20	26	o	8	No	1	+	..	..	18	No	No
21	22	o	3	No	1	+	..	..	13	No	No
22	26	o	12	Yes	1	+	..	..	20½	No	No
23	19	o	4	Yes	3	o	o	o	.....	Yes	Yes
24	35	4	36	Yes	3	o	o	o	.....	Yes	Yes
25	37	2	5	No	3	o	o	+	122½	No	No
26	33	2	12	Yes	3	o	o	o	.....	Yes	Yes
27	24	o	8	Yes	1	+	..	..	20	No	No
28	20	o	4	No	3	o	o	o	.....	Yes	Yes
29	23	o	15	Yes	3	o	o	o	.....	Yes	Yes
30	23	o	14	No	2	o	+	..	113	No	No
31	38	3	4	No	1	+	..	..	30	No	No
32	17	o	33	Yes	3	o	o	o	.....	Yes	Yes
33	22	1	11	Yes	3	o	o	o	.....	Yes	Yes
34	22	1	6	No	1	+	..	..	37	No	No
35	30	1	9	Yes	3	o	o	o	.....	Yes	Yes
36	24	o	8	Yes	3	o	o	o	.....	Yes	Yes
37	27	8	20	Yes	3	o	o	o	.....	Yes	Yes
38	19	o	14	Yes	3	o	o	o	.....	Yes	Yes
39	20	o	20	Yes	3	o	o	o	.....	Yes	Yes
40	28	1	13	Yes	3	o	o	o	.....	Yes	Yes
41	31	o	29	Yes	3	o	o	o	.....	Yes	Yes
42	22	o	35	Yes	3	o	o	o	.....	Yes	Yes
43	29	o	6	No	1	+	..	..	35	No	No
44	20	o	10	Yes	1	+	..	..	22	No	No
45	21	o	22	Yes	3	o	o	o	.....	Yes	Yes
46	43	6	21	No	3	o	o	o	.....	Yes	Yes
47	23	o	28	Yes	3	o	o	o	.....	Yes	Yes
48	28	3	18	Yes	3	o	o	o	.....	Yes	Yes
49	29	o	20	Yes	3	o	o	o	.....	Yes	Yes
50	23	1	16	Yes	3	o	o	o	.....	Yes	Yes

thirty-six days, with an average of thirteen days and a median of eleven days.

There was in each case some reason for performing the test. In some the time overdue was so short that an accurate diagnosis from pelvic examination alone was unlikely. Several patients were too obese for a satisfactory pelvic examination to be made. Others denied the possibility of pregnancy or insisted on some further assurance that the clinical diagnosis was correct. One patient was so near the menopause age that confirmation was desired.

Table II

Controls—pregnant women

Control no.	1	4	5	7
Age of patient	20	21	34	27
No. previous pregnancies	0	1	2	1
Days overdue	21	19	4	7
No. control injections	2	2	2	2
No. estrone injections	3	3	3	3
Diagnosis correct?	Yes	Yes	Yes	Yes

In each case an attempt at diagnosis was made from pelvic examination at the first visit. This impression was correct in forty-two patients of fifty, with a percentage of eighty-four per cent on pelvic examination alone. An incorrect positive diagnosis was made five times and an incorrect negative diagnosis three times.

Of the fifty women tested nineteen were shown by the test not to be pregnant; thirty-one were correctly diagnosed as pregnant. Of the non-pregnant women thirteen (68 per cent) menstruated after the first injection of estrone; four (21 per cent) after the second. Two (10 per cent) required three injections. In the nineteen non-pregnant women the shortest time required for bleeding to start after the beginning of the test (first injection) was one and one-half hours. The longest time was 134 hours, the average being 44.

As shown in the table the test was accurate in all cases with an accuracy of 100 per cent. This was determined by careful follow-up. One patient who was pregnant had a spontaneous abortion. Two admitted to having resorted to induced abortion. The others who were shown by the test to be pregnant have either been delivered or are well on their way to term. All those in the non pregnant group have continued with normal menses, or at least there is nothing sufficiently abnormal to call for medical attention.

Table III

Controls—non-pregnant women

Control no.	2	3	6
Age of patient	18	29	21
No. previous pregnancies	0	1	0
Days overdue	16	7	3
No. control injections	2	2	2
No. estrone injections	1	1	2
Flow—hours after last injection	14	40	11
Diagnosis correct?	Yes	Yes	Yes

Control Series. To provide a thoroughly accurate control series it would be necessary to administer three blank (inactive) injections followed by three injections of estrone over a period of two weeks. To obtain such controls involves difficulties in an office practice as few women will submit to this treatment when a pelvic examination will provide the same answer in about the same time. Since 90 per cent of non-pregnant women were found to menstruate after only two estrone injections, it was thought that administration of two blank injections followed by the test as described would provide a satisfactory control. Ampules of pure cotton seed oil were used for the control cases.

The control test was given to eight patients. Four of them failed to menstruate and were found to be pregnant. (Table II.) Three non-pregnant women were given the control test with results shown in Table III. The eighth patient, after two injections of cotton seed oil and two of estrone, discontinued the test and

apparently, from the information available, submitted to an induced abortion.

Since the statement of this pregnancy test limits its use to women who have a history of regular menstrual periods, it would not be surprising if some of them would menstruate while receiving control injections for they would all, presumably, menstruate sooner or later. It happened that none of the controls did this, but if some had done so it would not have invalidated the test. I believe that the fact that eight of the nineteen non-pregnant women in the non-control series were a week or more overdue when tested is even more significant than any control series could be. After the tables given here were completed a non-pregnant woman, aged nineteen who was twenty-eight days overdue, was given the test. She menstruated fifty-three hours after one estrone injection.

Stilbestrol by mouth was tried as a pregnancy test on one patient without success. When overdue three days, she was given the test as described herein, with oral administration of diethylstilbestrol, 5 mg. enteric coated, substituted for each estrone injection. Although the patient was not pregnant, she did not menstruate until five days after the third pill was taken. This patient, who was under sterility treatment, conceived twelve days after the beginning of this menstruation.

COMMENTS

In all of the various 250 patients whom I have tested for pregnancy there has been no difficulty whatever in interpreting the findings. All of the non-pregnant women had what appeared to be for them a fairly normal menstrual period. In a few of these women the rate of flow was reported as slightly increased, usually with some shortening of the duration of flow.

Practically all of the non-pregnant group were carefully questioned as to the passage of clots or tissue. If a woman was in the habit of passing small clots during menstruation, she usually did the same following administration of the test. One patient stated that this was more noticeable. No one ever stated that she passed large clots or anything resembling tissue.

It was thought that administration of estrogenic substance would produce abortion in humans, but this idea has been disproved by Vaux and Rakoff[9] and by Karnaky.[10] It is possible that it may do so in animals, including monkeys,(Hartman)[8] but in humans, on the contrary, estrogenic substances are now used in the treatment of threatened abortion and habitual abortion.

Those in the pregnant group, as shown by this test, reported no bleeding whatever. The only exception to this was one patient who told of noticing a spot of blood on her clothing the size of a five cent piece nineteen hours after the second injection. This was ignored in interpreting the test and the third estrone injection was given with no further bleeding noted.

In the light of the several suggestions for use of estrogenic substances for the prevention of abortion it is interesting to note that of the many patients who have received this test only one has had a spontaneous abortion. This patient reported spotting before submitting to the test. The accident occurred some weeks after the test was given.

None of the patients reported here were receiving any endocrine treatment at the time of the test, except for two who were receiving desiccated thyroid by mouth as part of the treatment for sterility. Both were correctly diagnosed by the test as pregnant. (Case Nos. 26 and 49.) Additional data will be required before one can know whether or not endocrine preparations interfere with the test.

THEORY OF TEST

In effect, the statement of this test for pregnancy says that the intramuscular injection of 3 mg. of estrone in divided doses in a pregnant women will not pro-

duce vaginal bleeding. This fact is sufficiently well established to need no further comment.

The statement further says, in essence, that any healthy woman with a history of regular menstruation who presents nothing abnormal on pelvic examination other than possible signs of pregnancy and whose menses are overdue will, if given 3 mg. of estrone in divided doses, have vaginal bleeding.

It is possible that menstruation occurring in non-pregnant women receiving the test is in a few cases coincidental; that is, it would have happened without treatment. However, it is unlikely that this occurs in many cases since 68 per cent of the non-pregnant women menstruated after the first estrone injection while only 10 per cent menstruated after the third dose and *all menstruated within twenty-four hours after the last injection.*

While the author has assumed that the vaginal bleeding in the non-pregnant patients reported here was true menstruation, there is no proof that it was such. However, the patients said that the bleeding appeared to be normal menstruation and later periods were reported as normal and approximately on time although not all were asked about the second menstruation. It is, of course, a common mistake for women expecting menstruation to assume that any vaginal bleeding is menstruation if it is not in abnormal amount.

Since we do not know the cause of *normal menstruation* in women,[11] any explanation of the mechanism responsible for the working of this pregnancy test can be only a surmise.

Although monkeys do not complain of overdue menstruation, certain animal experiments seem to bear out a plausible explanation for this test. The following conclusions were reached by Corner[11] as part of the results of his careful and brilliant studies on monkeys. Some of these findings were original while the others were confirmed by him:[11] (1) Estrone deprivation causes uterine bleeding. (2) The estrone-deprivation hypothesis in its simple original form is not adequate to explain the observed facts of menstruation. (3) Progesterone prevents estrone-deprivation bleeding and also prevents menstruation. (4) Progesterone deprivation, like estrone deprivation, causes menstruation-like bleeding. (5) *Estrone does not prevent menstruation.*

Corner tells of an interesting experiment,[11] carried out many times, that illustrates the last two of these points which are especially important here. A castrated female monkey was given a daily dose of estrone to build up the endometrium to a normal structure. After ten days of this a daily dose of progesterone was added so as to simulate the normal menstrual cycle. If the progesterone was stopped when ten doses had been given (twentieth day) while the estrone was continued, the monkey would invariably bleed after a few days in spite of the estrone.

The following theoretical explanation for the pregnancy test I have devised is based on the results of monkey experiments as just given: If we reason that delayed menstruation is due to progesterone secretion that persists because of incomplete degeneration of the corpus luteum, then the antagonistic action[8,11] of estrone against progesterone eliminates the last effect of the declining progesterone action and allows menstruation to begin.

There is no proof that I know of that delayed menstruation is due to persistance of the corpus luteum although from the results of animal experiments it is a likely explanation. Corner's theory of menstruation is based on the cyclic variation of progesterone.[11] However, merely because a certain endocrine action is noted in animals it does not mean that this action will be the same in women. The mistaken idea, adhered to for a number of years, that estrogens will produce abortion in women when the exact opposite appears to be true is an example of the harm that can be done when we are too insistent on carrying over ideas based on

animal experiments. There is no good reason for our always insisting upon animal experiments to back up our clinical experience when we have before us results of the action of drugs upon women which we can, with little effort, observe and record.

Another possible factor in this test is the hyperemia of the uterus (and other organs) produced by administration of estrogens.[12] Production of uterine hyperemia is offered as an explanation of the neostigmine methylsulfate pregnancy test.[5]

LIMITATIONS OF TEST

The pregnancy test herein described is applicable to the vast majority of those seeking a diagnosis as to pregnancy. The usual patient who comes for such a purpose is more apt to have a gleam in her eye and a bloom on her cheek than the tint of chlorosis; she is healthy and not anemic.

The greatest shortcoming of this test is that it is not applicable to a patient who is bleeding. The woman, whose vaginal flow is overdue for a period of days or weeks and then appears, is a constant worry to the physician. He must rely on a shrewd guess as to whether she is pregnant and act accordingly, or he must subject her to the possible danger of infection from a pelvic examination in order to make a diagnosis. This test is of no help in these frequently encountered cases. Although I have not attempted the test in a patient with ectopic pregnancy, it will probably prove to be of little value in this instance. The same holds true for mole and chorionepithelioma, but since such cases are comparatively rare, percentagewise, the test will prove satisfactory for routine use on most patients who walk into the physician's office.

As the test has been used on only four women approaching the menopause age, one reported here, caution should be used in the interpretation of results in such patients until more data is available.

SUMMARY

Of the many suggested tests for pregnancy none is entirely satisfactory.

A new pregnancy test, apparently highly accurate, is presented. It is inexpensive and simple to perform in the office without the use of animals or the aid of an outside laboratory.

In suitably selected patients, and nearly all can qualify, three injections of estrone in oil, 1 mg. each, are given over a period of five days.

If the patient fails to have vaginal bleeding within twenty-four hours after the third dose of estrone, she may be presumed to be pregnant.

The test has been 100 per cent accurate in over 250 cases. Fifty cases are presented, with controls.

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MANAGEMENT OF ANOXIA DURING PENTOTHAL ANESTHESIA*

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INTRAVENOUS administration of pentothal sodium for the production of surgical anesthesia has received increased use since the first clinical trial fourteen years ago. Various clinical investigators have attested its value for short surgical procedures, control of convulsions, major abdominal intervention and induction previous to inhalation agents.[1–4] It is well recognized that this drug has a special depressant action upon the respiratory centers causing retardation in respiratory exchange, diminution in tidal volume and even respiratory arrest.[5,6] These depressant effects usually result in direct proportion to the concentration and especially the rate of injection of the drug. Respiratory depression occurring in the upper levels of anesthesia is usually temporary but in the later stages becomes prolonged because the respiratory centers are then deprived of their metabolic support.[7] The phenomenon of sudden respiratory arrest in light anesthesia may be avoided by the slow, intravenous administration of pentothal and when this precaution is observed progressive diminution of breathing becomes consistent with the metabolic inhibition of the brain.[8]

The methods of administration of this drug and the attempts to avoid anoxia are varied. Some anesthetists allow the patient to breathe only air; others administer oxygen either by nasal catheter, by BLB mask or anesthetic machine.[9–13] These variations in the management of anoxia reveal a lack of knowledge concerning the effects of pentothal anesthesia upon the arterial oxygenation and the level of carbon dioxide in the blood stream during the various stages of anesthesia.

A recent investigation by Etsten and Himwich[7] has demonstrated that the signs and stages of pentothal anesthesia may be correlated with an underlying physiologic mechanism. These investigators[1] have shown that the course of pentothal anesthesia can be divided into four stages. stage I, analgesia; stage II, hypersensitivity, stage III, surgical anesthesia: plane 1, light; plane 2, moderate; plane 3, deep; stage IV, impending failure.

They have also observed that during the first and second stages the retardation of cerebral metabolism occurs predominantly in the cortex and that a metabolic depression of the entire brain up to the medulla occurs during deep anesthesia. In addition to the metabolic effect there is another, inhibition of the activity of certain cerebral areas including the respiratory centers. This two-fold action of pentothal explains the variations in the degree of arterial oxygenation during anesthesia. Some of the signs of anoxia, such as cyanosis, tachycardia or bradycardia, tachypnea and hypertension may be masked or missed during the clinical course of pentothal anesthesia, particularly in the surgical stage. The irreversible damage to the brain caused by severe anoxia is only too often discovered in the postoperative period. The purpose of this paper is, therefore, to determine the degree of oxygenation of the blood during pentothal anesthesia, determinations which are to serve as a guideline to the limits of safety.

METHOD

A 1 per cent solution of pentothal sodium was administered intravenously to non-premedicated and non-operative subjects. The solution was controlled either by an intravenous drip or syringe connected in

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series with a two-way stopcock and needle inserted into the antebrachial vein. The patient was anesthetized slowly so as to avoid any undue respiratory depression.

Arterial blood samples were drawn from the femoral artery while the patient was in the resting state and during the various stages and planes of anestheisa. The blood samples were kept under glass and over mercury in order to avoid any contaminating exchange of gases with air. The samples were analyzed for oxygen content, oxygen capacity and carbon dioxide content by the method of VanSlyke and Neill.[14]

RESULTS

Thirty-eight observations were made on eleven patients. The data obtained (Table I) indicate that respiratory activity is adequate in stage I, stage II and plane I of stage III. In the second and third planes of stage III respirations are depressed as shown by marked arterial oxygen saturation and carbon dioxide retention.

The arterial oxygen saturation of the subjects in the resting state ranged from 92 to 96 per cent and the anesthetized subjects in stages I and II had similar percentages of saturation as shown in the accompanying illustration. In plane I of stage III the saturation varied from 87 to 86 per cent, values still within the comparatively safe zone of oxygenation. In plane 2 of stage III arterial oxygen saturation ranges from 77 to 82 per cent with an average of 82 per cent. In plane 3 of stage III the anoxia becomes even more marked with an arterial oxygen saturation average of 40 per cent and usually a definite increase in arterial carbon dioxide content.

The arterial carbon dioxide contents during the various stages of anesthesia are found in Table II. Each patient served as his own control and the variations are demonstrated as the patient was subjected to different stages of anesthesia.

COMMENT

The most frequent result of pentothal anesthesia was a retention of carbon dioxide in the blood stream which became marked in the deeper stages of anesthesia. Nevertheless, this retention was not observed in all instances. The accumulation of carbon dioxide in the blood can be accounted for by diminution of the respiratory exchange. This diminution is caused

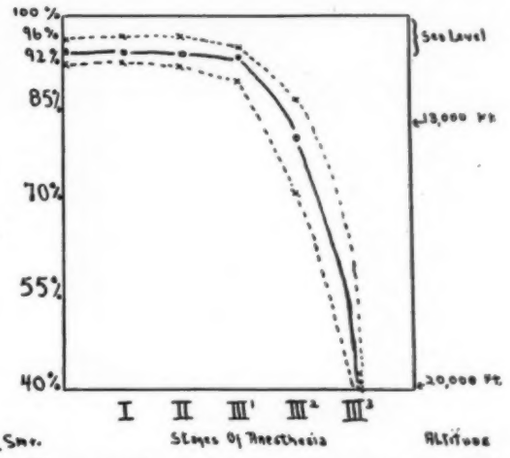

FIG. 1. The arterial oxygen saturation as determined in the various stages and planes of pentothal anesthesia is compared to the arterial saturation of a non-anesthetized person breathing air at different altitudes.

by the depressant action of pentothal upon the respiratory centers plus the partial withdrawal of their metabolic support. This retention of carbon dioxide indicates that the sensitivity of the respiratory center to its normal physiologic stimulus is diminished. Moderate increases of carbon dioxide in the blood stream may enhance muscle tonus or sharpen sensitivity to a painful stimulus, perhaps by inhibiting the cholinesterase.[15] This rise of carbon dioxide may be one of the reasons for the muscular response to pain which may occur in the deeper stages of narcosis. Such hypersensitivity will mask the depth of anesthesia and when more drug is given to overcome this muscular reaction an excessive degree of central depression develops after the painful surgical stimulus is withdrawn.

The progressive reduction in arterial oxygen saturation during pentothal anesthesia is marked in the stage of moderate surgical anesthesia and severe in the stage of deep surgical anesthesia. Here, as with carbon dioxide, the clinical state of anoxia and degree of depression of the respiratory center may be masked in the stage of

TABLE I*
ARTERIAL OXYGEN CONTENT AND CAPACITY DURING PENTOTHAL ANESTHESIA

No.	Stage	Arterial O_2 Content	Arterial O_2 Capacity	Arterial O_2% Saturation
1	Control	15.65	16.32	95
	Stage III, plane 3	14.21	16.32	87
2	Control	16.73	17.57	95
	Stage III, plane 3	15.85	17.57	91
3	Control	18.22	19.65	94
	Stage II	17.86	19.45	92
	Stage III, plane 1	17.17	19.45	88
	Stage III, plane 2	15.46	18.81	82
	Stage III, plane 3	15.89	20.81	84
4	Control	19.65	20.84	94
	Stage II	18.12	18.88	96
	Stage III, plane 1	17.47	18.59	94
	Stage III, plane 2	16.33	18.59	88
	Stage III, plane 3	7.27	18.88	38
5	Stage II	16.82	18.48	91
	Stage III, plane 2	14.98	18.48	81
6	Control	19.78	20.82	95
	Stage I	17.08	17.90	95
	Stage III, plane 1	16.86	18.49	91
	Stage III, plane 2	15.97	17.90	89
	Stage III, plane 3	15.28	18.49	83
7	Control	19.24	20.25	95
	Stage III, plane 1	17.98	19.72	91
	Stage III, plane 2	15.56	19.72	80
8	Control	18.29	19.11	96
	Stage II	18.83	19.61	96
	Stage III, plane 1	18.80	19.61	96
9	Control	20.47	22.14	92
	Stage I	19.65	22.14	93
	Stage II	19.23	21.14	91
	Stage III, plane 1	18.50	21.29	87
	Stage III, plane 2	8.88	21.29	42
10	Control	18.05	18.50	97
	Stage II	17.73	17.81	99.5
	Stage III, plane 2	13.01	17.81	73
11	Control	17.33	18.59	93
	Stage II	15.59	15.92	98
	Stage III, plane 1	15.29	15.92	96
	Stage III, plane 1	15.72	16.59	95
	Stage III, plane 2	13.45	15.92	84
	Stage III, plane 3	6.37	16.59	38

* The oxygen content and capacity of the arterial blood was analyzed in eleven patients. Each patient was subjected to different stages of pentothal anesthesia. Analyses checked to 0.2 volumes per cent.

moderate surgical anesthesia. This masking can be attributed to: (1) Stimulation of the carotid bodies in response to the arterial desaturation; (2) the periodic stimulation of the respiratory center by painful stimuli evoked during surgery and (3) the peripheral vasodilatation produced by the increased carbon dixoide in the blood stream. It is in this stage of moderate surgical anesthesia that the administration of oxygen is imperative. The method of administration is not so important at this time as long as the atmosphere that the patient inspires is adequately enriched with oxygen to fully saturate the arterial blood.

In the stage of deep surgical anesthesia the arterial oxygen saturation falls to dangerously low levels as was previously stressed. The respiratory center is depressed to such an extent that both the

TABLE II*
ARTERIAL CO_2 CONTENT DURING PENTOTHAL ANESTHESIA

No.	Stage	CO_2 Content
1	Control	52.47
	Stage III, plane 3	56.43
2	Control	52.97
	Stage III, plane 1	58.47
3	Control	51.20
	Stage III, plane 2	54.0
4	Control	50.40
	Stage III, plane 3 J	61.61
5	Control	53.32
	Stage II	46.94
6	Control	54.26
	Stage II	50.39
7	Control	52.66
	Stage I	50.53
8	Control	53.32
	Stage III, plane 2	56.07
9	Control	51.20
	Stage III, plane 1	50.61

* The carbon dioxide content of the arterial blood is determined in the resting state and in a definite stage and plane of pentothal anesthesia. Each patient serves as his own control.

accumulated carbon dioxide and the anoxic stimulus via the carotid body mechanism can no longer evoke respiratory stimulation.

Administration of oxygen by insufflation either by nasal catheter, by BLB mask or anesthetic mask and bag increases the oxygen saturation of the blood and alleviates the anoxia but, nevertheless, the carbon dioxide will steadily increase. When the anoxic stimulus to the carotid body during pentothal anesthesia is removed by administration of oxygen, breathing becomes more shallow. The carbon dioxide content of the arterial blood is increased because the maintenance of a normal level of this gas is dependent upon active and adequate respiratory excursions.[16] When breathing is greatly depressed, the tidal exchange of physiologic gases, including the carbon dioxide in the alveoli, will increase.[17] Therefore, it is necessary to enhance the inspiratory effort and, in turn, augment the exchange of gases. In this stage of pentothal anesthesia it is important not only to administer oxygen by anesthetic face mask and bag but also to supplement respirations by manually compressing the breathing bag during each inspiratory effort. The aforementioned method is intended to simulate normal respirations so that the concentration of carbon dioxide does not accumulate either in the alveolar spaces or blood stream. This is not intended to lower the carbon dioxide but to keep it within normal limits. The technic as outlined will not only remove the excess carbon dioxide but also will improve oxygenation.

SUMMARY

Experimental evidence is presented demonstrating that the intravenous administration of sodium pentothal produces anoxia and an increase of carbon dioxide content in the blood during moderate surgical anesthesia and deep surgical planes of anesthesia.

The institution of oxygen therapy by insufflation is insufficient to correct the depletion or accumulation of the blood gases during the deep planes of anesthesia. Supplemental respiration technic of oxygen therapy is the most efficient method that can be instituted during pentothal anesthesia to avoid anoxia and hypercapnea.

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THE TALCUM POWDER EVIL*

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THE talcum powder chapter is a long one, dating back more than sixty years. It was not, however, until 1942 that any extensive work was done with the aim of developing a substitute to use in place of talc. By that time the complications reported in the literature as caused by talc became so numerous that workers in the Barnard Free Skin and Cancer Hospital, St. Louis, Mo., spent the better part of five years systematically studying the effects of some thirty-five different powders on laboratory animals. These experiments led to the conclusion that potassium bitartrate made a desirable substitute for talcum. However, as time passed it developed that unless gloves powdered with potassium bitartrate were sterilized with meticulous care the powder tended to caramelize. We also thought at that time that potassium bitartrate shortened the life of rubber gloves. On this latter point we were probably in error because the Wilson Rubber Company, on their own initiative, instituted a series of careful experiments which showed that potassium bitartrate neither shortened the life of the gloves nor lessened the tensile strength of the rubber. (From a personal communication to the author.) Despite this we received so many personal reports concerning the difficulties encountered with sterilization that we decided to reopen the problem in order to continue our search for a more suitable powder. It is interesting to note that at about this time the Mayo Clinic substituted potassium bitartrate for talcum and reported later that they had been using it for two years.

Our later studies developed the fact that corn starch would serve as an ideal powder were it not for the fact that it gelatinized when subjected to steam autoclaving. Thanks to the Corn Products Refining Company we learned that by subjecting starch to formaldehyde or to other aldehydes it could be robbed of its gelatinizing properties. But here again we ran into difficulty in that one must remove very completely all traces of the aldehyde radical in order to avoid an irritating dermatitis of the hands of some surgeons. Another difficulty was that the sterilized starch powder did not have complete freeness of flow. This problem of free flow, however, I do not regard as of too great importance. I believe that the best operating room technic calls for use of the powder in the form of sachets rather than from shaker cans. When sachets are used, the question of free flow loses much of its significance.

In the March, 1948 issue of *The American Journal of Surgery*—there appeared an article by workers of the Johnson & Johnson Laboratories, of New Brunswick, N. J. This report is a bit confusing because although they seem to recommend a modified starch, they do not say how it is modified nor do they call it starch. They refer to it as "a mixture of amylose and amylopectin derived from corn starch." I had always been of the opinion that corn starch was a mixture of amylose and amylopectin and starch chemists assure me that such is the fact. In a specimen of their powder that the Johnson & Johnson workers very kindly sent me I found evidence of the presence of aldehyde of some sort upon testing with Schiff's reagent. Chemists who repeated the test for me also reported the presence of aldehydes.

Another statement in the report of the Johnson & Johnson workers that causes me genuine concern is that their powder

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contains 1 per cent magnesium oxide in order to furnish a freer flow to the powder. In the work that I already referred to which was done at the Barnard Free Skin and Cancer Hospital magnesium oxide was one of the many powders that were tried. It was found to cause granuloma and plaque formation and was therefore discarded. We did think that it was somewhat better taken care of than was talcum, but it took a varying period of time before it was disposed of. During that time interval it could cause a great deal of harm. The situation is much like that which pertains to calcium carbonate. In their studies of noxious dusts workers in the United States Bureau of Mines reported that the only innocuous dust they found was calcium carbonate, in that although it did set up a reactionary inflammation in the tissues it was finally disposed of.

There is no doubt about the correctness of the observation of the Johnson & Johnson workers that magnesium oxide will increase the flow of starch. The manufacturers of table salt have known for a long while that by adding a little magnesium oxide they could prevent clumping and furnish freer flow to the salt. The fact that it will increase the flow of starch, however, does not warrant the use of magnesium oxide in a surgical dusting powder. This statement is valid, I believe, even if it is present in a 1 per cent dilution. I am strongly inclined to believe that the presence of insoluble dusting powders in the tissues and particularly in the peritoneal cavity may cause damage totally out of proportion to the quantity of the material. In some instances a very small amount of an offending powder may set up an almost incredibly progressive chronic type of fibrosis. I have come to the conclusion, therefore, that when we are contemplating the harmfulness of nonabsorbable surgical dusting powders, there is as little justification of talking or thinking in terms of "just a little bit" as there is of speaking of "a touch of pneumonia" or of a "little bit pregnant."

It is a hopeful sign that such an outstanding manufacturer as Johnson & Johnson has interested themselves in the surgical dusting powder problem, but that does not relieve surgeons of their duty to know just what they are using and how assuredly safe it is.

SCALENUS ANTICUS SYNDROME TREATED BY SURGERY AND SKELETAL TRACTION

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THE writing of this article has been prompted for two reasons: First, because it has been the author's experience that very often the scalenus anticus syndrome is overshadowed by definite organic disorder in the cervical spine and hence not recognized; secondly, to present again before the profession a method of treatment, namely, skeletal traction to the cervical spine for those cases which have not responded to the ordinary conservative measures and in which surgical treatment is contraindicated or refused by the patient.

Since the publication by Adson and Coffey in 1927 on the surgical treatment of so-called "scalenus anticus syndrome," considerable knowledge has been added relative to the etiologic factors of the syndrome and its treatment. In spite of all this, it is surprisingly true that this syndrome is too often overlooked or unrecognized by physicians and surgeons and the patient's symptoms often assumed to be on a functional rather than on an organic basis. On the other hand, the syndrome having been recognized, the surgeon often fails to recognize the exciting factor which initiated the syndrome. This often leads to improper management of the patient and failure to alleviate the symptoms. Success in the treatment of this syndrome can be brought about only by first recognizing the entity and establishing the etiologic exciting factor responsible for the symptoms and secondly, by directing the treatment not only to the spastic or contracted scalenus anticus muscle but also to the responsible exciting factor when demonstrable.

Symptoms. The scalenus anticus syndrome is characterized by a distinct nervous and circulatory phenomenon in the affected extremity. The nervous phenomenon is always present; the circulatory manifestations are rarely severe. The sensory symptoms are pain and paresthesia in the involved extremity. The pain is usually along the flexor and ulnar surfaces of the forearm, shoulder, angle of the scapula, pectoral muscles and often in the root of the neck and ear of the affected side. Later there may be muscular involvement; the thenar eminence may show definite atrophy (atrophy of the abductor pollices muscle and opponens pollices muscle) or there may be atrophy of the interossei muscles. These motor changes, however, are only rarely present.

The circulatory manifestations consist of decreased temperature, numbness and formication in the extremity. There is often a dusky hue and puffiness of the hand and forearm. Later definite trophic disturbance makes itself evident in the form of pallor, followed by cyanosis of the finger tips and eventually gangrene. Diminution of the radial pulse is a common finding. The radial pulse can be decreased, even obliterated by downward traction on the involved extremity, or by having the patient perform Adson's maneuver.*

A great number of patients present only a few of the above findings, the most common symptoms being the sensory manifestations. This is especially true in the early stages of the syndrome. A very common finding, however, is tenderness in the supraclavicular fossa, especially over the distal one-third of the scalenus anticus muscle immediately lateral to the sternocleidomastoid muscle. Very often the scalenus anticus muscle is found on palpation to

* In Adson's maneuver the radial pulse decreases in volume or becomes obliterated when the patient extends the cervical spine and rotates the head toward the affected extremity while taking a deep breath.

be tense, contracted and even hypertrophied. Pressure over this area elicits considerable tenderness and the pain is aggravated in the flexor surface of the arm.

Etiology. It is apparent from the foregoing symptoms that we have in this syndrome a disturbance of the normal physiology of the brachial plexus, of the subclavian artery and vessels of the affected extremity. It is generally accepted that the nervous manifestations are the result of irritation of the brachial plexus, especially of its middle and lower trunks. Irritation and stimulation of the plexus causes a spasm and contracture of the scalenus anticus muscle, which in turn causes an elevation of the first thoracic rib. The abnormal position of the first thoracic rib causes greater stimulation of the plexus whose branches supply the scaleni muscles; hence, a vicious cycle is established. Ochsner, Gage and De Bakey in 1935 set forth this explanation of the syndrome, without the presence of a cervical rib. This leaves much to speculation, however, as to what was the initial factor causing the stimulation of the plexus. When there is a demonstrable cervical rib or an abnormal cervical transverse process, one can assume that these factors are sufficient to initiate the syndrome. However, we know that many patients with cervical ribs do not have symptoms and as pointed out by Adson and Coffey in 1927 only thirty-six of 303 cases with cervical ribs had symptoms of sufficient severity to necessitate treatment. Fifty-five per cent of the 303 patients with cervical ribs had no symptoms. It becomes obvious, therefore, that even in the presence of a cervical rib and where no demonstrable pathological condition is present in the cervical spine, some other factor or factors come into play initiating the stimulation and irritation of the brachial plexus.

At this point it is appropriate to review the normal anatomy relative to the brachial plexus, subclavian artery and scalenus anticus muscle in the supraclavicular area. The scalenus anticus muscle arises from the transverse process of the third, fourth, fifth and sixth cervical vertebrae. The muscle runs forward and downward to insert into the scaleni tubercle of the first rib. The cervicobrachial plexus runs laterally and behind the scalenus anticus muscle. Between the muscle and the first rib lie the brachial nerve trunks. The subclavian artery occupies a similar position. The scalenus anticus receives its nerve supply from the sixth cervical nerve root.

There is still considerable controversy relative to the abnormal physiology responsible for the vascular manifestations. Todd in 1912 expressed the belief that the symptoms were the result of stimulation of the sympathetic fibers in the lowest nerve trunk. Telford and Stafford in support of this view went still further and demonstrated in cadaver studies the presence of sympathetic fibers in the lowest brachial plexus trunk in the form of a distinct bundle whose position in the trunk readily predisposed it to pressure in the presence of a cervical rib. On the other hand, Gladstone and Wakely were of the belief that the symptoms in the syndrome are due to direct pressure on the plexus and subclavian artery. A review of the literature on this subject reveals, however, that most authorities are of the opinion that the nervous manifestations are the direct result of compression of the plexus causing irritation of the nerve fibers, while the vascular phenomenon is best explained on the premise that it is the result of irritation of the sympathetic fibers in the lowest trunk.

Predisposing Factors. There are several predisposing factors which may or may not be present. Certainly the presence of a cervical rib is to be considered as a predisposing agent in the presence of the syndrome. However, not all cases of cervical ribs give rise to symptoms. Adson explains this on the basis that only those patients have symptoms in which the scalenus anticus muscle inserts into the first rib by means of a broad fibrous tendon, hence the space between the scalenus anticus muscle and the cervical rib is greatly diminished. On the

other hand, symptoms are absent in those cases in which the muscle insertion is narrow and more mesial.

Congenital anomalies of the cervical vertebrae may also be predisposing factors. In such incidences the brachial plexus is often in an abnormal position relative to the surrounding structures.

Congenital anomalies of the scalenus anticus muscle itself may be present. In one case the lower two brachial trunks pierced the belly of the muscle.

Jones considered that the post-fixed plexus was more apt to develop the syndrome than the prefixed plexus. The component fibers of the lowest trunk of the post-fixed plexus arise from the upper thoracic segments of the spinal cord while the main portion of the prefixed plexus arises from the cervical segments of the spinal cord. In the former type of plexus, the nerve trunks are predisposed to irritation and stimulation because of their angulated position over the cervical or first thoracic rib.

Exciting Factors. There are many exciting factors which may initiate the syndrome. Todd pointed out that descent of the shoulder beyond normal limits in adulthood, especially in women, is a factor which may cause irritation and stimulation of the brachial plexus. Gladstone and Wakely were of the opinion that in the presence of cervical ribs the short ones produced compression of the brachial plexus while the long ones produced compression of the subclavian artery giving rise to the vascular symptoms. On the other hand, Adson believes that the scalenus anticus muscle was the principal agent in causing compression of the plexus. He further maintains that it is most likely to cause compression of the brachial plexus during the period of greatest activity and muscular development.

Posture must also be considered as an exciting factor. The syndrome is seen in many individuals with long necks and drooping shoulders. This abnormal droop of the shoulder girdles may very readily cause stretching, irritation and stimulation of the brachial plexus.

CASE REPORTS

Case I. M. B. had a bilateral scalenus anticus syndrome. No disorder was found in the cervical spine or in either shoulder girdle. She was a tall, thin woman with a long neck and drooping shoulders. The syndrome had come on gradually, first in the left extremity and then in the right extremity about five months before seen by the author, March 15, 1940. She obtained immediate relief by strapping her shoulders to a T splint as used in clavicular fractures. The patient was then taught exercises to elevate and pull back the shoulder girdles. As long as the patient continued her exercises and maintained this position, she was free of pain. The patient remained free from pain until June 20, 1941, when she returned with the same set of symptoms. She had, however, neglected her exercises and had slumped into her former poor posture. This patient came to surgery and was relieved of all symptoms.

Another exciting agent is trauma, direct or indirect, to the brachial plexus or scalenus anticus muscle. Severe downward pressure on the shoulder has been the exciting factor in several patients whom the author has treated. This was also noted as the starting point of the syndrome in several marine recruits starting their training period. The symptoms came on after carrying heavy packs on their shoulders for long periods of time. In the following case the symptoms followed severe stretching of the upper extremity.

Case II. M. V., a female, age thirty-two, was first seen on February 8, 1939, and gave the following history: While wringing out clothes, her left hand was caught in an electric wringer and in an attempt to pull out her hand she jumped backward and severely wrenched her left shoulder. On admission the left hand showed numerous contusions on the dorsal surface. There were no fractures. The patient complained of severe pain in the root of the neck, in the left shoulder and along the entire arm. The treatment outlined was rest of the arm in a sling and physiotherapy in the form of heat and massage to the entire extremity. Within two weeks there was complete recovery of the contused hand. Pain in the shoulder and arm, however, was more severe. Motion of the

cervical spine and of the shoulder joint was unrestricted. She complained of numbness and coldness in the entire forearm, more so along the flexor surface. The fourth and fifth fingers were, as the patient stated, "dead." The entire hand had a blotchy appearance. Pain was exaggerated upon performing Adson's maneuver. Pressure over the root of the neck on the left side exaggerated the pain. Some relief was obtained if the patient placed the left hand over her head. When last examined on September 3, 1941, the patient still complained of the same set of symptoms. During the period from the date of her injury to the date of this last examination the patient had been to numerous physicians, but all treatment failed to give any relief. She presented a typical scalenus anticus syndrome, undoubtedly due to stretching of the cervicobrachial plexus at the time of the injury. A division of the scalenus anticus muscle relieved all symptoms.

Occupations which tend to cause an abnormal droop of the shoulder or pull the shoulder girdle downward have been the exciting factor in several of the author's cases.

There is still another group of patients in whom this vicious syndrome is the result of stimulation of the cervicobrachial plexus or of the scalenus anticus muscle by demonstrable disturbance in the cervical spine. In these incidences treatment should primarily be directed toward relieving the spasm of the scalenus anticus muscle. It is in this group that the syndrome is often overlooked because it is overshadowed by the obvious organic disorder in the cervical spine.

Case III. T. V., age twenty-six, was admitted on June 5, 1939, complaining of severe radiating pain in the left shoulder and arm. There was no history of trauma. The onset was gradual, starting with some stiffness in the neck three months before admission. Examination of the patient revealed a young adult male holding his head slightly forward and supporting the left elbow with his right hand. Motion in the cervical spine was restricted in all directions. There was severe muscle spasm of the posterior cervical group of muscles and of the trapezius and sternocleido mastoid muscle on either side. Pressure over the root of the neck on the left side caused severe radiating pain down the left arm along the flexor surface of the forearm and into the fourth and fifth fingers. The skin of the left arm was hypersensitive and the dorsum of the hand was slightly swollen. The grip of the left hand was definitely diminished and the volume of the radial pulse was also diminished. X-ray examination revealed a tuberculous lesion affecting the fourth and fifth cervical vertebrae and a collapse of the intervening intervertebral disc. The patient was put to bed on June 21, 1939, and a spine fusion was done from the second cervical vertebrae to the seventh cervical vertebrae. The cervical spine was immobilized by a plaster jacket including the head and neck. Ten days following the operation he was completely free of shoulder and arm pain and made an excellent recovery. When last examined on September 21, 1941, he had solid fusion from C-2 to C-7 inclusive and was free of pain.

The scalenus anticus syndrome, in this instance, was either due to stimulation of the scalenus anticus muscle by the pathologic process present in the fourth and fifth cervical vertebrae or the pathologic process of the affected bodies caused direct irritation of the fourth and fifth cervical nerves and hence set off the same syndrome.

Case IV. C. H., a male, age forty-three, was struck on July 14, 1938, on the back of the neck by a swinging chain suspended from a derrick. He was taken to the hospital where x-rays revealed a compression fracture and forward subluxation of the fourth cervical vertebra. The patient complained of more pain in the left shoulder and arm than of pain in the neck. The fracture and subluxation were reduced and a plaster jacket was applied holding the neck in a position of hyperextension. In spite of a perfect reduction the patient continued to complain of severe radiating pain into the left arm and into the fourth and fifth fingers. He also complained of numbness and coldness of the left hand. The dorsum of the hand was somewhat puffy and the grip of the hand was weakened. The volume of the left radial pulse was equal to that of the right radial pulse. The patient made an uneventful recovery. However, he always had some pain in the left

arm and hand which was characterized by periods of exacerbations.

When last examined on September 17, 1941, the patient still complained of radiating pain in the left shoulder, arm and hand. There was slight but definite atrophy of the muscles of the hyperthenar eminence. The hand had a

Fig. 1. Position of patient lying in traction.

glossy appearance. Pressure over the root of the neck on the left side exaggerated the pain. Traction downward on the left arm also exaggerated the pain. If the head was turned toward the affected side and extended, the pain was more intense. The radial pulse was equal to that of the unaffected side. A scalenus anticus syndrome in this case was undoubtedly initiated by trauma to the fourth cervical vertebra which in turn caused an irritation either of the scaleni muscles or cervicobrachial plexus. A division of the scalenus anticus relieved all the symptoms.

Case v. In L. W. the syndrome was associated with advanced osteoarthritis of the cervical spine. The cervical spine was immobilized by a leather cervical collar for a period of six weeks. During this period intensive physiotherapy was administered in the form of heat and massage. The scalenus anticus syndrome began to disappear gradually as soon as the cervical spine was immobilized. In this case, however, the pain in the left shoulder and arm has never completely disappeared and there have been two periods of exacerbation of the syndrome. In each instance the syndrome was relieved by the application of the cervical collar.

The group of patients in which no gross pathological condition is demonstrable in the cervical spine or shoulder girdle present a more difficult problem. Some of the patients, as previously stated, have a long neck and drooping shoulders. In these cases it may be assumed that the cervicobrachial plexus is being stretched by an abnormal descent of the shoulder girdle. Many of

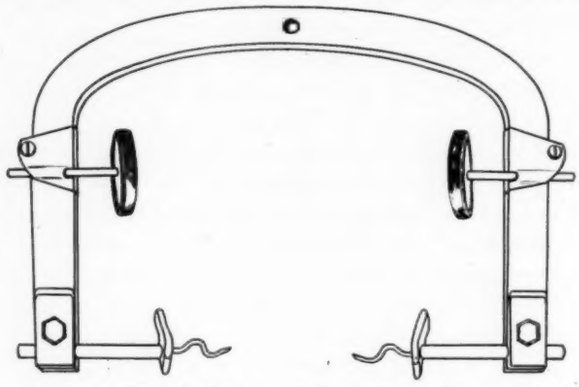

Fig. 2. Standard type of skeletal traction used.

these patients may be relieved and even cured by improving their posture.

Treatment. The milder forms of this syndrome in many instances will respond to conservative measures. Where there is evidence of poor posture characterized by drooping shoulders, corrective exercises and some type of support to pull the shoulder girdle up and backward will give considerable and prompt relief. If the syndrome has been initiated by the patient's occupation, a change of employment following a period of rest will suffice to bring about relief. When the syndrome is the result of direct or indirect trauma to the scalenus anticus muscle, rest to the part with the arm in an elevated position will give relief. These simple measures may at times have to be augmented by a sedative or by the injection of procaine into the scalenus anticus muscle. The procaine injection may have to be repeated several times before permanent relief of the symptoms is obtained.

When the conservative measures fail, one will have to resort either to traction on the cervical spine or to the division of the scalenus anticus muscle. I prefer surgical treatment to traction. However, there are many patients who refuse surgery or in whom surgery is contraindicated. In this group traction to the cervical spine is the treat-

ment of choice; and if properly applied and carried out, traction will invariably result in the relief of symptoms. I will admit that it is a more trying ordeal than surgery nevertheless in the selected cases it is warranted and justified. (Figs. 1 and 2.)

I prefer to use skeletal traction. Traction is obtained by means of steel hooks inserted beneath the zygomae. The steel hooks are inserted subperiosteally beneath the zygomae after the skin, underlying tissues and periosteum have been first infiltrated with procaine. Straight traction is made on the cervical spine by means of 5 to 10 pounds of weight. The patient lies on a flat, firm bed with no pillow under the head. The head rests on an even plane with the shoulders. If the hooks are properly applied, there is no pain or reaction at the sites of insertion of the hooks. Nursing care is facilitated because the patient is free to move about at will. The symptoms usually disappear within six to eight hours after traction has been applied. Traction is maintained for ten days after which the patient is made to wear a light cervical collar for two weeks. During this period heat and massage is given daily to the neck. To date seventeen patients have been treated by traction by the author. As yet only one has had recurrence of symptoms and this patient was relieved by surgery.

The following is an analysis of patients with scalenus anticus syndrome who were treated either by surgery or traction. There were eighteen males and thirty-two females. The age ranged from fifteen to fifty-eight years while the duration of the symptoms ranged from one day to thirty-four years. In five cases the syndrome came on immediately after direct trauma to the cervicobrachial plexus or scalenus anticus muscle. Twelve patients had associated organic pathological conditions of the cervical spine. Advanced osteoarthritis was found in eight; two had a tubercular lesion of the cervical spine and in two the symptoms followed fracture dislocation of the cervical spine. Cervical ribs were found in eight patients, two of whom had bilateral cervical ribs.

The nervous manifestations were the most prominent symptoms in all cases. Thirty-four had vascular manifestations of varying degrees; in nine of these, however, the circulatory findings were the prominent factors of the clinical picture. Six had no circulatory disturbances. Thirty-three patients were treated by surgery and seventeen by traction. In the first group twenty-six were completely relieved; seven patients still had some residual pain in the affected extremity but to a lesser degree than before operation. Of the seventeen patients treated by traction, all were relieved of pain except one who had a recurrence of symptoms. This patient was finally relieved by surgery.

SUMMARY

1. Scalenus anticus syndrome is a common entity and a cervical rib may or may not be present.

2. Most authorities believe that the nervous manifestations are the result of pressure on the lower trunks of the brachial plexus, while the vascular phenomenon is due to stimulation of the sympathetic fibers in the lowest trunk of the brachial plexus.

3. The syndrome may be initiated by stimulation of the cervicobrachial plexus which in turn causes contraction of the scalenus anticus muscle. As a result of this contraction the thoracic rib is elevated into an abnormal position compressing the nerve trunks and subclavian artery which lie between the scalenus anticus muscle and the first thoracic rib. A vicious cycle ensues.

4. It is possible that the syndrome may also be started by contraction of the scalenus anticus muscle due to direct trauma or irritation of the muscle. This may well explain the etiology of the syndrome in cases with a demonstrable organic disorder in the cervical vertebrae and in those patients who have a fracture dislocation of the cervical spine.

5. Treatment should be directed both to the etiologic factors and to the contracted scalenus anticus muscle. Symptoms will often disappear with adequate treatment of the demonstrable condition if present in the

cervical spine. If this fails, the treatment should be augmented by a direct attack on the scalenus anticus muscle.

6. Many cases with mild symptoms will respond to conservative measures. If these fail, the patient should choose treatment either by traction or surgery. The author prefers surgery if not contraindicated.

7. Skeletal traction is an excellent method of treatment for selected cases.

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MODIFIED OPERATION FOR CARCINOMA OF THE RECTUM WITH PRESERVATION OF THE SPHINCTER*

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TOO many patients life with a colostomy presents unendurable difficulties. Surgery today is well aware of the maxim —preserve the sphincter and save the carcinoma.

FIG. 1. Carcinoma of rectum *in situ*.

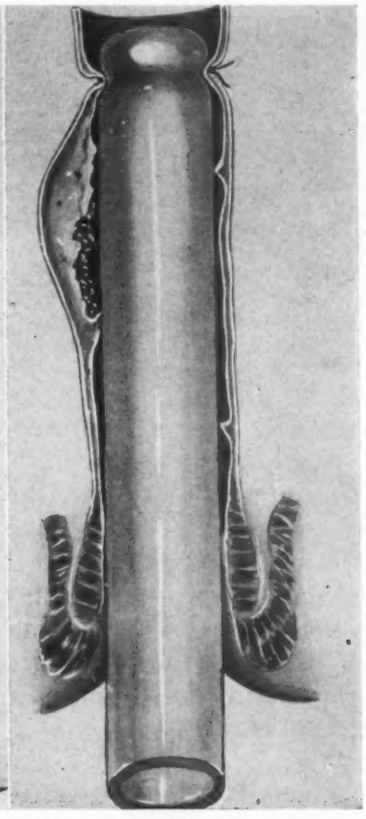

FIG. 2. Catheter in rectum beyond lesion.

There is no doubt that abdominoperineal resection done in either one or two stages is the ideal procedure for the majority of patients with carcinoma of the rectum. However, there are a certain select number of cases of carcinoma of the rectum in which it is possible to remove the carcinoma and adjacent lymphatic tissue adequately and at the same time maintain intestinal continuity with preservation of the sphincter.

A number of procedures with this end in mind have been used with varying degrees of success. For example, the telescoping procedure of Von Hochenegg,[1] the telescoping procedure by the Whitehead method,[2] the Kuttner method,[3] the sphincter preservation method by Bacon,[4] the Babcock method[5] and more recently the

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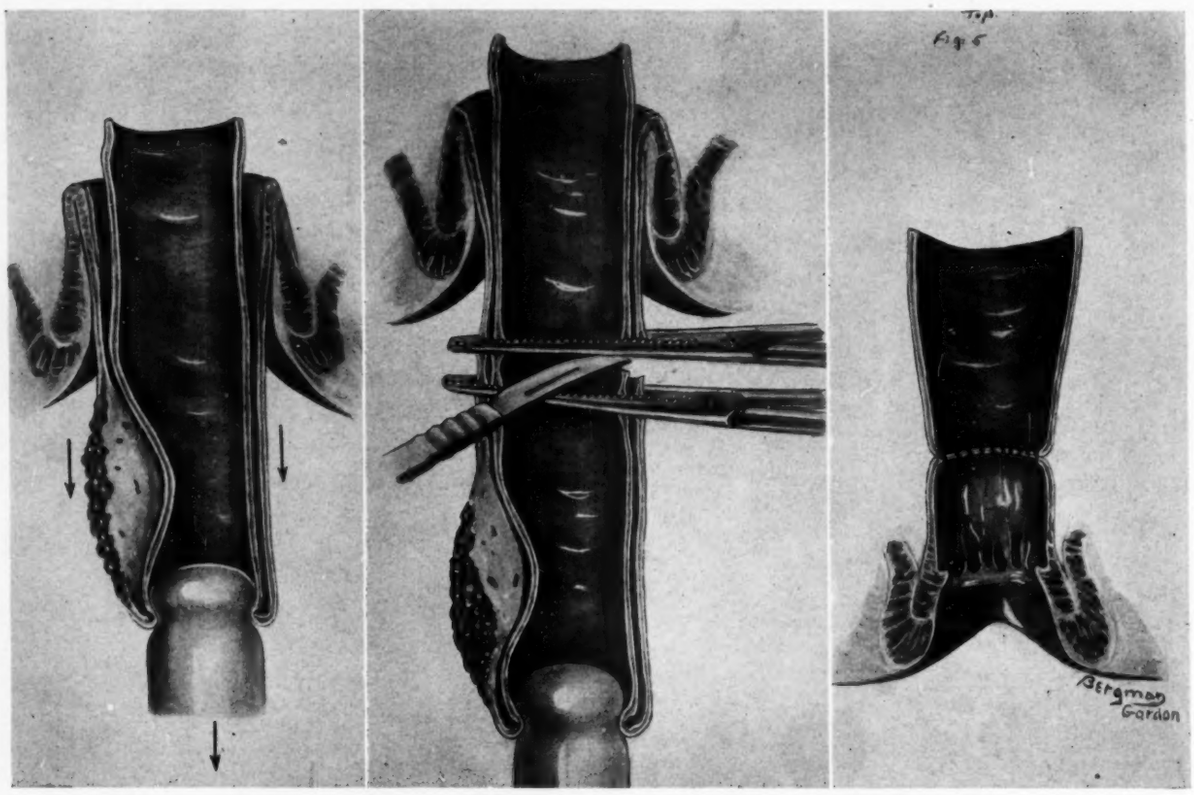

FIG. 3. FIG. 4. FIG. 5.

FIG. 3. Rectum with lesion pulled out of anus.
FIG. 4. Excision of rectum with growth.
FIG. 5. Anastomosis completed and reposited through anus.

closed anastomosis with ampullary resection as reported by O. H. Wangensteen.[6]

The operation we are about to describe presents all of the advantages of the above mentioned procedures and avoids several of the difficulties and disadvantages inherent in other procedures. There is no loss of sphincter control and there is direct visualization of the lesion. Anastomosis is performed outside the body.

There are three prime requisites: First, the lesion must be small, second, it must not extend beyond the fasia propia (Fig. 1), and third, there must be a mobile sigmoid.

Several days before operation each patient is fed a diet high in carbohydrates and protein and low in fat. Prior to operation the bowel is emptied by repeated colonic irrigations. Sulfasuccidine, vitamines B, C and K are administered. Repeated transfusions are given until the patient's hemoglobin is 85 per cent or over.

OPERATIVE TECHNIC

Continuous spinal anesthesia is induced with repeated injections of sodium pentothal introduced into a previously established glucose and saline intravenous infusion.

A right paramedian incision is made with the patient in steep Trendelenburg position. The abdominal portion of the operation is identical to the usual abdominoperineal procedure, namely, dissection of peritoneal flaps lateral to the colon, ligation of the superior hemorrhoidal vessels at the level of the sacral promontory and mobilization of the rectum anteriorly from the bladder or vagina and posteriorly beyond the tip of the coccyx by blunt dissection.

A lap pad is placed in the abdominal wound. The patient is then placed in the lithotomy position. The anus is dilated manually and a No. 28 Babcock catheter

is introduced through the anus to a distance of 8 cm. above the lesion. (Fig. 2.) A suture is placed around the bowel catching the end of the catheter with the suture which is then tied tightly around the gut. (Fig. 2.)

While the assistant guides the bowel from above, it is invaginated through the rectum and out of the anus. This results in an extra-anal intussusception of the lower sigmoid and rectum (intussusceptum) through the anus. (Fig. 3.) This is excised 5 cm distal to the anus, resulting in removal of the lesion with a portion of normal gut above and below the lesion as well as all gland-bearing tissue. (Fig. 4.) The cut edges are approximated with interrupted sutures going through all layers. (Fig. 5.) The anastomotic site is then reposited through the anus gently. A No. 22 rectal tube is inserted through the anus to a distance of 10 cm. above the site of anastomosis and the tube is anchored to the perianal skin with one suture on each side. A drain is inserted into the perirectal space through a stab wound into the ischiorectal fossa.

The assistant thereupon straightens the sigmoid avoiding undue tension on the line of anastomosis. A new peritoneal floor is made by closing the peritoneum carefully around the sigmoid. An appendicocecostomy is done through a small right McBurney's incision to keep the anastomosis at rest, and the abdomen is closed in the usual manner.

Postoperative Care. The drain to the perirectal space is withdrawn after decision that any possible leak in the posterior suture line is not productive of any symptoms. The rectal tube either comes out of its own accord or is removed on the sixth postoperative day.

When a urethral catheter is used, small doses of sulfadiazine should be given daily to prevent any urinary infection. Wangen steen suction is used for forty-eight hours postoperative; 2,500 to 4,000 cc. of fluids and amino acids daily are given parenterally to maintain fluid nitrogen and acid-base balance.

This procedure permits early discharge from the hospital and perfect sphincter control, and obviates formation of rectal fistulas and strictures.

SUMMARY

A modified operation for carcinoma of the rectum with preservation of the sphincter is presented for use in selected cases.

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ERRORS AND EVILS OF EPISIOTOMY

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FOR those conditions in which delivery of the fetus is difficult because of the narrowed or deformed nature of the pelvic bones, cesarean section is used with reservation. Within reason and necessity, it is a life-saving operation to both mother and child. The misfortune of obstetric management is that a more serious operation has become popular in order to cater to the doctor's convenience and showmanship and alleviate the patient's fear.

Some of these advantages, even though false, are secured in a time-saving operation of attack upon the continuity of the pelvic floor. Efforts have been made to warrant its common use by a seemingly harmless name, episiotomy, which means cutting of the pubes or vulva structure outside of the abdominal wall. This is an unfortunate error. The pelvic floor structure which lies between the head in the pelvis and delivery is the caudal musculofascial lower abdominal wall, composed of five layers of fascia and three layers of muscle. The vulva cut if limited to episiotomy has nothing to do with the question. When the musculofascial plates is entirely cut by a side incision, these tissues are cut beyond replacement and injured beyond normal repair.

The vulva and pubes are ornamental structures outside the pelvic floor which impede the head. The plunging of a knife or scissors into this closely constructed musculofascial plate obliquely does damage to each of these structures and puts them beyond rational repair by even a fair surgeon, to say nothing of its universal popularity among untrained men. The author has had opportunities of observing these instances from the beginning of its modern popularization. The weak points have not been confined to the novices. One is not expected to do good work if he does not know the structures which he mutilates, and is not thus true if he is operating nominally entirely outside the so-called pelvic floor in performing an episiotomy while in reality he severs all eight layers of the lower wall of the abdomen.

First, the pelvic floor is seen at times mutilated beyond all repair. Second, the pelvic floor is usually mutilated beyond normal reconstruction in the hands of the performer. Third, the resulting efficiency is decreased from 100 per cent to from 50 to 0 per cent. Fourth, the evils, in addition to these lacks of anatomic and functional faults, are: (1) lack of support; (2) multiple and extensive herniation; (3) infection, scar tissue and fistulas; (4) a high percentage of lack of satisfactory grasp in sexual life, in numerous cases being so unsatisfactory as to threaten a divorce or actually bring it about; proper repair has avoided divorce in the threatened cases; (5) bladder and urethral difficulties have been common and in many cases extensive.

In cases in which a deep oblique incision has been made, leaving that side useless, the author has had the best results by a deep, median and superficial union of the remaining portion of that side of the pelvic floor outside the incision to the deep medium and superficial structures of the untraumatized side. In many cases no structure is found until well out toward the tuberosity on the cut side and on the uncut side the rectum, vaginal commissure and original median perineal region will be found retracted to the uncut side 1 to 1½ inches while this and the paralytic cut side exhibit an expression like Bell's paralysis

which the author has termed the facies perinei.

In the interest of useful repair we are in favor of median pelvic floor section to reach a delayed or an impacted pelvic head. Repair is much more sure. After careful delivery I would pronounce tears more amenable to repair than deep oblique incisions.

Marbury and Goldman, in *The Journal of the American Medical Association*, point out their experience with episiotomy in cases of fistula. Cases of this nature have been met in consultation work and would seem almost inevitable in such blind invasion of the deep and complicated structures of the pelvic floor under the name of episiotomy. Either we do a deep and unmanageable operation and call it by a soft spoken superficial name, or we do what the name signifies when it is entirely unnecessary and inadequate; for episiotomy would not dispose of any smallness of the outlet which might exist.

A real enlargement must attack the pelvic floor; and as such an effort cuts through all of the muscles and fascia of the lower abdominal wall, it would be appropriate to term it "a pelvic floor section" which reaches the head in the pelvic abdomen instead of applying a term which has no proper significance. If the median section leaves the two halves of the pelvic floor similar or alike, it renders it amenable to easy and accurate repair by one who possesses knowledge of surgery and the anatomy of the pelvic floor.

A close study of the purpose of languages reveals the extensive efforts which have been made to provide us a careful study of words, and we are remiss in using the term episiotomy for a procedure which does not correspond at all to the meaning of the word.

MARSUPIALIZATION

A SURGICAL PROCEDURE FOR THE ERADICATION OF PILONIDAL CYST AND SINUSES

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THERE are many procedures practiced for the removal of pilonidal cysts and sinuses. The following methods, all of which aim at either the removal or destruction of the cyst wall, are being advocated by surgeons who follow their cases through. The methods are as follows: primary closure, primary closure with drainage, block excision with pedicle flaps, injection of sclerosing agents, local cyst excision and electrocautery.

Marsupialization or exteriorization, a surgical method proposed by Buie,[1] can be used in certain types of infected pilonidal cysts and sinuses. This is not the answer to all types for surgical cure but is another method in the armamentarium of the surgeon. It is indicated particularly, we believe, in pilonidal disease associated with large undermining abscesses and secondary lateral tracts, the extirpation of which produces a tissue defect difficult and dangerous to close primarily.

Pilonidal disease was found frequently in the Services, especially in the young age group. The cause of pilonidal disease is very much disputed but the two most accepted theories of origin are those proposed by Fox[2] and Stone.[3] However, the possibility of the glandular theory, namely, disturbances of the pituitary gland, cannot be overlooked.

The mortality associated with the surgical procedures is practically nil; the attendant period of postoperative disability is prolonged. In private practice we are concerned primarily in obtaining a cure and the length of convalescence is to a large extent of subordinate consideration. However, in the Services, the surgeon must consider (1) estimated time loss from duty, (2) possibility of recurrence and (3) relief of symptoms for as long a period as possible.[4]

Prior to going into the Army, one of us (S. J. F.) had considerable experience with block excision with primary closure while being associated with the late Dr. W. Kress McIntyre. The results obtained from this procedure in seventy-two cases were very good, with only seven patients requiring a second operation. However, time was not an important factor, the operation being more or less elective. Hospitalization averaged sixteen days and loss from work thirty-five days. While in the Service we found that a different problem existed where time in the hospital was an important factor not only in the treatment of pilonidal disease but in every hospital admission. The main reason for this was that when individuals were admitted to the hospital for treatment, they were not to be discharged to duty before being physically fit for field duty. This meant that time not only for operative recovery was to be considered but also the convalescent period. One thing which was never considered, and in many cases a very important item, was the psychiatric make-up of the individual patient.

While in Army hospitals in this country the operative treatment for pilonidal disease was mainly a one-stage procedure—block excision with approximation by catgut or cotton—the results obtained were variable due to the number of different surgeons who had occasion to do the surgery. There was no push for man power in this country, and to all intents and purposes the care of the individual soldier with pilonidal disease remained elective only to flare up very shortly on his arrival at the overseas destination.

In the E.T.O., we had occasion to treat these patients and the period of hospitalization was a prime factor in the selection of the method of surgery. Operations (one-stage procedures) were performed on individuals who gave a history of recurrence with minimal amount of discharge at time of examination. We found it expedient to use the method of marsupialization in those patients with purulent drainage and in some with acute infection. The results obtained, we believe, were as good as those obtained by other methods.

The principles of the marsupialization or exteriorization method are sound, in that (1) it provides adequate drainage; (2) one conserves the pre-existing skin or, if that has been destroyed by previous inflammation, it preserves the granulation tissue already formed; (3) since tissue is not removed, save for the small portion of the roof, a natural pad over the area is left in place with a result of lessened chance for the appearance of a tender scar and (4) time for convalescence is much lessened.

The individual presents himself with a history of a painful swelling on his "tail bone" which might be the first attack, or he gives a history of repeated attacks with the possibility that at one time the swelling had been incised. Examination reveals an indurated area at the level of the sacrococcygeal junction, in midline, measuring from 1½ cm. in diameter to 5 cm. in diameter with one or more dimples present in midline. The dimples when probed will be found to go superiorly; and if more than one is found, probes inserted in each dimple will make contact with each other.

Preoperatively the patient should have plain water enemas the night before operation until the returning water is clear. The operative area should be shaved, including both buttocks, the upper thighs and the perianal skin. Medication should consist of a sedative the night before and two hours preoperatively, morphine and atropine to be given forty-five minutes before operation.

Fig. 1. Marsupialization fourteen days postoperatively.

The patient is then brought to the operating room and a spinal anesthetic is administered. We have found that the patient experiences less after pain and discomfort from a low spinal anesthetic than from any other anesthesia. The patient is then placed on his abdomen and at least ten minutes are allowed to elapse before anything further is attempted. The area is then cleansed with ether, alcohol and an antiseptic, and the drapes arranged.

The grooved director is inserted in the superior dimple as far as it will go and then the overlying skin is incised. The grooved director is then placed in successive inferior dimples and the overlying skin is incised. It will then be found that all the dimples coalesce either subcutaneously or from the abscess cavity. An Allis forceps is placed on either side of the incised skin, traction is placed on the cut surfaces laterally and the abscess cavity is probed in all directions for subterranean tracts. The picture is that of a granulative wound; in some cases hair or gelatinous products are present in the abscess cavity. The cyst wall is then wiped dry with a dry sponge and the abscess wall is evident. Using a curved scissors, the overlying skin is excised at

approximately the outer edge of the abscess cavity. Small hemostats are applied to the bleeding points and the skin is then approximated to the base of the cyst wall either with a running suture of catgut or interrupted sutures of cat gut or non-absorbable suture. Sulfanilamide powder is dusted onto the wound and vaseline gauze applied over this; a gauze dressing and then an adhesive binder are applied.

The patient is returned to his room and lies on his abdomen. A liquid diet is allowed after the first day and this is gradually increased until a regular diet is taken on the third postoperative day. The dressings are removed on the third or fourth postoperative day and hot sitz baths instituted; the wound is protected by vaseline gauze between soakings.

After five to seven days the sutures have either disappeared or are removed and the reddened surrounding area has returned to normal. The line of suture uniting the cyst wall and skin reveals firm union. The patient leaves the hospital on the eighth day and continues taking the sitz baths until the wound is healed. A regular diet is followed and the patient is advised not to take any athletic exercise. At the end of two weeks he may return to his work provided it is not of a strenuous nature.

Within a short time after this a transition occurs in the secretory function of the epithelial lining which gradually lessens and appears as a dry, shiny surface. After four weeks, and in some instances less, the operative site is marked by a purplish line with practically no depression of the marsupialized remnant and adequate padding by subcutaneous fat over the sacrococcygeal area.

CONCLUSION

In conclusion we are proposing that marsupialization, a method for the surgical removal of pilonidal cysts and sinuses, be used more in the future. The method is simple, hospitalization is decreased, the patient while convalescing is unrestricted in his movements and complications are minimal.

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INSERTION OF THE SMITH-PETERSEN PIN*

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NOT infrequently we have seen a person past middle age admitted to the ward with so-called surgeon's headache or the previously unsolved fracture, namely, "fracture of the neck of the femur." In many institutions even today, particularly if not urbanly located, the proverbial spica cast is applied. After a few days or a week a pneumonic constipated person is found in a soiled, soggy, wet cast. In another two weeks x-ray shows slipping and coxa vera deformity due to a loose cast occasioned by reduction of swelling, muscle atrophy and weight loss. It is for these reasons, as well as others, that a plea is made for more general use of the Smith-Petersen pin or other fixative agents.

Historically, the first fracture of the neck of the femur was recognized by Ambroise Pare who lived in the era between 1510 and 1590. He initially confused it with a dislocation. The first fixation was done by Von Langenbeck in 1858 using a nail for fixation. Others followed with different types of nails, spikes and screws until in 1912 Dr. Fred Albee used autogenous bone grafts. In 1934, Gaenslen used rustless steel spikes 3/32 of an inch in thickness. All used splints of some sort. Dr. Smith-Petersen in 1931 devised a pin bearing his name and he employed the intracapsular approach.

The injury is slight and indirect. Often an ordinary twist of the hip causes the fracture with the resultant fall, and not vice versa, so that in a few moments an elderly individual is transformed from a self-sufficient creature to a pitiful, helpless heap. Bilateral femoral neck fractures have been known to occur with convulsive therapy, such as shock-induced treatments.

The type of fracture determines the prognosis. The nearer the fracture is to the base of the head the less the vascularity, the poorer the healing, and the longer the non-weight-bearing period will be. To this it should also be added that the better the nailing the more effective the result. According to location, intra or extracapsular types are known as well as whether or not they are subcapital, transcervical or intertrochanteric. A less known division is the adduction type in which the fracture line tends to be vertical through the neck, and the abduction type in which the fracture line is obtuse or more horizontal. In the former, shearing of the fragments occurs and there is more displacement and poorer healing. In the latter the weight-bearing plane is nearer normal and if displacement is minimal, no fixation or reduction is necessary because it will heal without either as it tends to impact itself.

Femoral neck fracture is an exception to the dictum that most all fractures are emergencies, apropos, of course, of pinning. Immediate immobilization is imperative, either by tying both feet and legs together or by the use of a long wooden splint with a triangular bandage in the groin tied to the notched top and traction from the tied foot to the notched bottom or the usual Thomas splint. Upon hospitalization some traction with weight may be added to overcome muscle spasm and relieve pain. Shock is treated from the beginning. Negative water balance, plasma proteins, cardiac decompensation, diabetes, pneumonia and possible traumatic alcoholic psychoses are considered with competent medical con-

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sultation. Usually within two to four days the patient is ready for operation. Sulfadiazine is given prophylactically. The immediate preoperative preparation includes emptying of the bowel and bladder, shaving of the lower abdomen and hip area, allowing fluids up to four hours before operation. Three gr. of nembutal or seconal is given two hours before taking the patient to the operating room. Sips of water are permitted on the table providing there is no tendency to nausea or vomiting.

The preferable anesthesia is spinal, using 15 mg. of pontocaine or 200 to 300 mg. of neocaine. This is given in the fourth lumbar space with the patient lying on his side. If necessary, sodium pentothal may be supplemented. This amount of anesthesia will be sufficient, if necessary, for two hours of work.

Hip pinning may be done by any competent operator. Naturally it is presumed that one has an anatomic knowledge of the area involved so that one at least respects and is tolerant of commonly accepted rules of procedure. After a third or fourth case they are relatively simple.

To save time, which in these cases is lost waiting x-ray development, reduction of the fracture is not accomplished until the patient has been given the anesthesia and is draped. The patient should be in the supine position, with an x-ray casette tunnel placed under the involved hip with its open end directed to the opposite or uninvolved side. In this way the drapes are not disturbed on the operative side when taking the films. Antiseptic painting includes the lower abdomen, operative site, groin, buttock and thigh to the midleg. A sterile pillowcase envelops the foot and leg to below the knee and is closely tied by a sterile bandage. No metal clip is necessary to hold the drapes within the anteroposterior or lateral x-ray views.

Reduction of the fracture is accomplished by Leadbetter's method which is as follows: The hip is flexed to the right angle and lifted up before it is internally rotated, abducted and then extended. During this maneuver the pelvis is held firmly on the table by an assistant. When the leg is extended, traction is applied by the assistant so that coxa valga or as near to that position as possible is maintained. The foot is held in inversion. This maneuver will reduce all fractures when early diagnosis and reduction has been made. Those with fractures that have been neglected for one to four weeks will need a more rotary motion and pull in the direction of internal rotation. Loud crepitus is heard in reducing a fracture over a few weeks old. The Leadbetter method is so positive in the early cases that no radiographic check is necessary until the guide pins have been inserted. When the patient's heel is held in the palm of the hand and there is no tendency to lateral rotation of the foot beyond approximately 15 degrees and the length is comparable with the normal leg, the fracture is said to be reduced. This is known as the heel-palm test. On the other hand, when the foot moves out to more than 50 per cent lateral rotation, the fracture is not reduced. The distal part of the neck lies posterior to the proximal part and it is pulled upward by the biceps femoris, psoas and hamstring muscles. In cases which are of four to five weeks' duration, reduction should be attempted followed by x-ray in the anterior and lateral views before painting, draping and insertion of the guide wires. If reduction is not accomplished, intra-articular reduction and nailing is indicated in which case there is further vascular interference and surely more chance for avascular necrosis of the head. This is rare in extra-articular fixation. Leadbetter's method is definitely contraindicated in intertrochanteric or pertrochanteric fractures. A new fracture will ensue in the shaft at the level of the lesser trochanter.

The incision should be approximately 4 to 5 inches in length over the greater trochanter, extending through skin, superficial fascia, tensor fascia femoris and vastus lateralis fascia. A point 1 inch below the lower mid-border of the greater tro-

Fig. 1. Transcervical femoral neck fracture.

Fig. 2. Reduction and insertion of two guide wires.

chanter on the lateral surface is selected and two heavy Kirschner wires, 9 inches long, are inserted into the neck for about 4 inches at slightly upward angles, being placed at a 45 degree angle to the shaft and with an upward inclination of 15 degrees. This can be accomplished by the eye or by countless other devices and gadgets. One of the best is the Engle May direction finder. Watson-Jones uses a short guide wire with a handle attached after gouging out a ¼ inch opening in the bone. It is important that the leg be held with some traction and the foot inverted and maintained in this position. Dr. Nicola has the feet held by an assistant with both great toes markedly inverted which brings the femoral neck on each side to a horizontal plane. In this way the pin need not be tilted 15 degrees upward upon its insertion. Some men use leg holders, the thigh being held in abduction with a levelometer attached to maintain inversion of the femur. However, there is always a possibility that this might slip and interfere with circulation.

It is at this point that the first x-rays should be taken, anteroposterior and lateral views. One or the other guide wire is usually in good line with the reduced fracture. If this is not the case, the unsatisfactory one is removed and another is inserted to make an attempt at improvement of the position of the good wire. A repeat x-ray is done for a check, or omitted if sufficient experience has been had with this work. The guide wires should extend to the articular surface of the head but no great harm will result if it is accidentally penetrated. This is done so that on driving the Smith-Petersen pin over the guide wire there will be no tilting of the head or proximal fragments. This could occur to 45 degrees with the first impact of the hammer. The x-rays having been taken the Smith-Petersen pin, usually 3¼ to 3½ inches, is threaded over the most satisfactory guide wire and inserted the full length. This is done only when the poorly inserted guide wire is removed. To insert the pin with both guide wires left in place is not good technic because

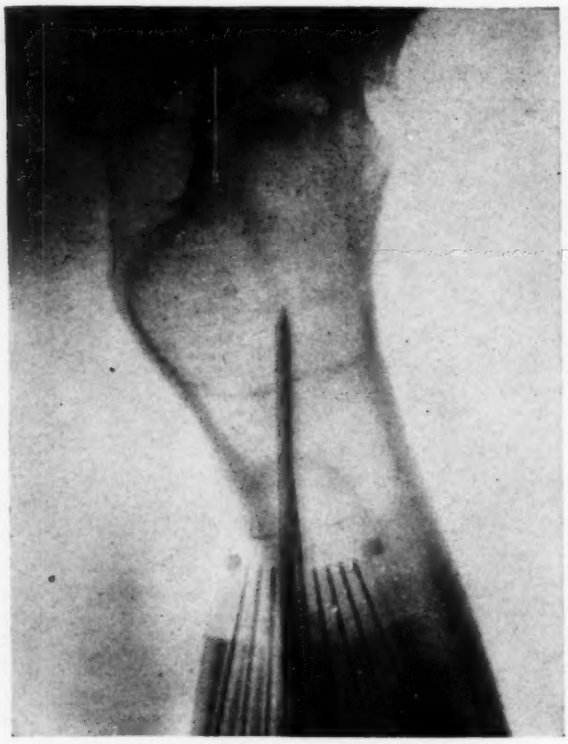

FIG. 3. Lateral view of guide wires in Figure 2.

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FIG. 4. Insertion of the pin, anteroposterior view.
FIG. 5. Insertion of the pin, lateral view.

the unused wire is apt to be bent and cause a great deal of difficulty in removal. Watson-Jones and Kellog Speed insist upon accurate insertion and accurate size of the pin. However, the author sees no reason for this mathematical accuracy as illustrated in the accompanying x-rays. (Figs. 1 to 10.) Surely the pin must not penetrate the head or even be too near its articular surface. One-quarter of an inch is close enough to allow for some absorption of the neck or the adjacent fractured surfaces which become necrosed, liquefied and absorbed. As the nail is driven in care should be taken to see that the guide wire does not go in with the nail as the latter is inserted. It is important to always stop ½ inch short of the cortex of the shaft with a 3¼ inch nail, then removing only the second or final wire. When the next x-ray is taken, it can be driven in a little further in the process of impaction.

Some operators say that impaction is not necessary. It is an accepted fact that impacted fractures heal better than those which are not impacted. After the final x-rays are taken and before the wound is closed every fracture should be impacted, the amount being apparent. Naturally there is some impaction with each blow of the hammer but with the impactor instrument it can be increased according to the force of the blow. There is no reason for attaching an extra nail from the end of the pin to the shaft of the femur to prevent slipping. If there is any neck shortening, penetration to the joint is more apt to take place. Overlapping and close

Fig. 6. This type of pin approaches an abduction type fracture.

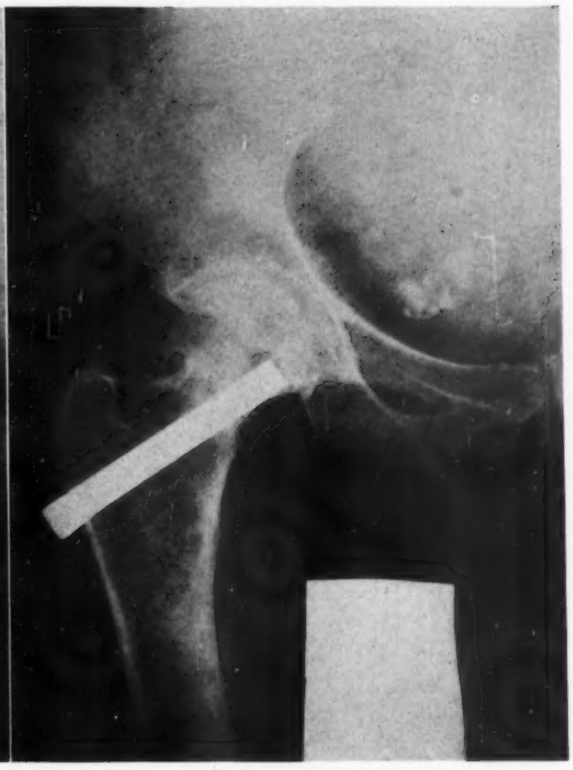

Fig. 7. The pin is too low in the neck as well as too horizontal.

suturing of the fascia over the end of the nail will tend to prevent slipping. A final x-ray is taken in two views and the wound closed without drainage using continuous chromic No. 1 for the fascia and well spaced, interrupted black silk for the skin. No splint is applied to the leg, above all a spica, which defeats one of the purposes of the pin. The only exception may be the application of a one-sided spica for a month or two if, in the final x-ray, the lateral view demonstrates that the pin is off center and close to the edge of the neck. Finally all motions are tested by moving the leg and thigh freely and gently.

The patient is returned to bed and the leg placed on a pillow with the usual post-operative care of the bladder, pain, water balance, encouragement of deep breathing as well as general nursing care. After a few days quadriceps muscle exercise is encouraged and at the end of a week full flexion of the knee is possible. Chemotherapy is continued for at least a week at which time the patient may use a wheel chair. Crutches may be used as early as is commensurate with the strength and agility of the patient.

As to weight bearing the more experienced concepts should be accepted. No fracture is completly healed until the fracture line is no longer visible. The minimum for this fracture is six months; the maximum a year or even two. Dr. S. Kleinberg allows weight bearing in about a month. He uses the Thompson "Z" nail by direct visualization, intracapsularly. This nail can be cut with shears, it is not as strong as the Smith Petersen pin and also the blood supply is further lessened by open capsular approach.

Healing depends upon the blood supply as well as approximation by pin fixation. The head and neck of the femur are vascularized in four ways: (1) diaphysial, through the nutrient artery of the femoral shaft; (2) periosteal, through vessels in the periosteum from innumerable fine branches of any artery near it; (3) epiphyseal, this is the capsular group from the anterior and

FIG. 8. This depicts neck absorption but it is a live flattened head.

posterior circumflex arteries from the profunda; (4) the ligamentum Teres group, namely, a branch of the posterior division of the oburator artery. The ligamentum teres is attached to the fovea centralis of the head and this anatomic area is located in all femoral heads in the lower posterior part. Perforation of this structure with the pin, causing vascular destruction, is possible but improbable due to the 15 degree upward tilt taken on inserting the pin. Interference with any one source will result in a disturbance of bone metabolism proportionate to the importance of the supply affected. This factor is a most important one since it concerns bone regeneration. Most of these fractures are very irregular and comminuted; it is never a straight through fracture. Therefore, the repair is more involved and extensive, including necrosis, decalcification, liquefaction, absorption, granulation and calcification.

What size nail should be used and how far should it be inserted? This depends on two things: the length of the femoral neck and head, and the distance below the greater trochanter that it is inserted. The distance in any femur from the articular surface of the head to ½ inch below the greater trochanter varies in adults from 3½ to 4¼ inches. If the technic of the operator is one in which he inserts the pin 1 to 1½ inches below the greater trochanter, then he must use a longer nail, especially so if he is dealing with a subcapital or high neck fracture. Otherwise, the pin will not be sufficiently within the head or proximal fragment. The aforementioned is considered good technic because of the more vertical line of stress and strain. A 3¼ inch nail is sufficient, believing it possible to bury it beyond the cortex of the shaft if necessary.

Engle May calculates the distance of the neck accurately by proportion, namely, the ratio of the actual length of the direction finder is to its length on the x-ray plate as the actual length of the femoral neck (which is X) is to the length of the neck on the x-ray. Another method for calculating the size pin to use is knowing the length of the guide wire inserted (9 inches), how much of it is in the bone and how much is out and subtract the difference. This method holds only if the wire is inserted approximately ¼ inch from the articular surface of the head. And again, another ¼ inch must be allowed for impaction or the absorptive process at the fracture site.

When the x-ray is taken at the time of the accident, it should include both hip joints so that an estimate can be made of the relative size and length of the neck and also the amount of normal coxa valga. During the pinning, anteroposterior and lateral views are imperative, otherwise one does not know if the pin is truly in the neck. Anteroposterior views are easy to interpret but to read properly the lateral view the plate must be held so that the shaft is horizontal and the neck and head extend upward at an angle. It is confusing in the calculations to have the neck and

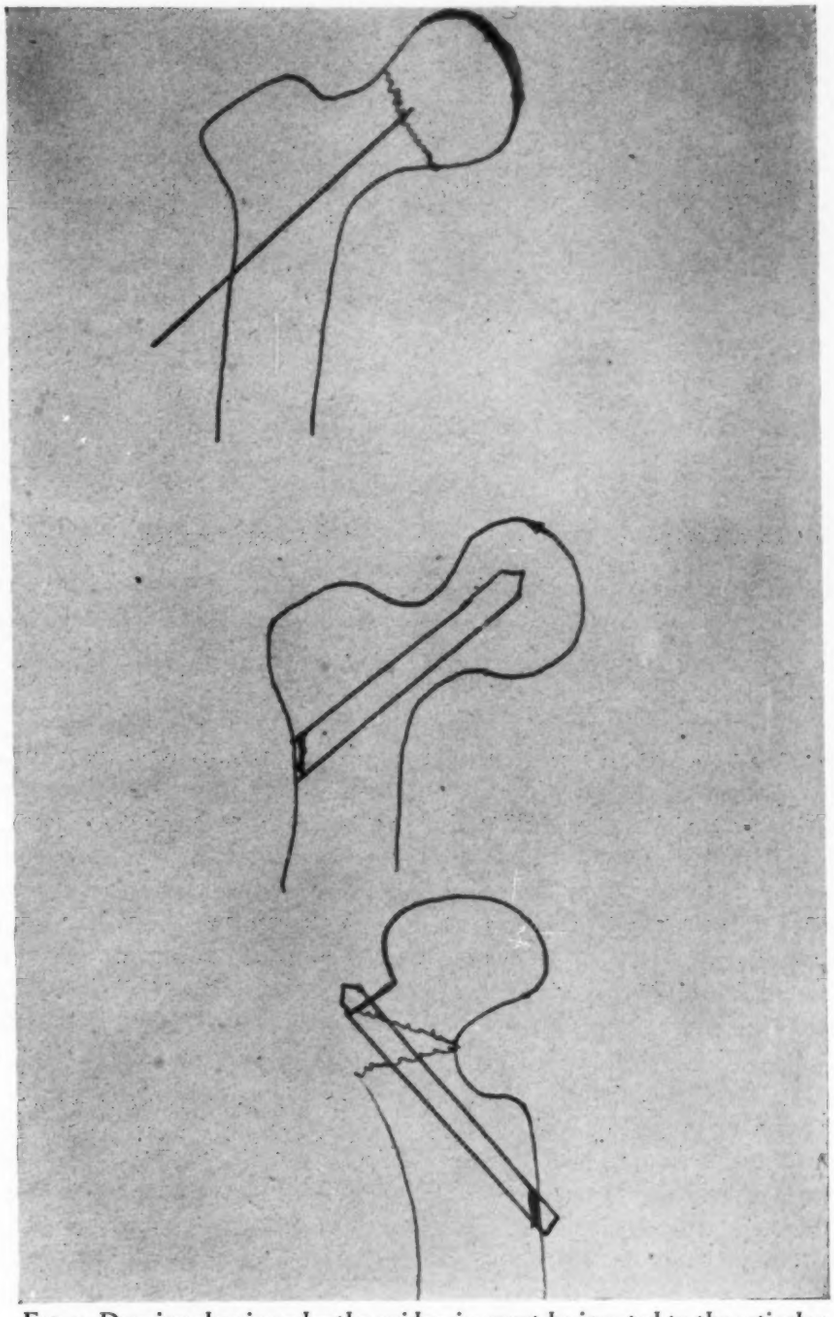

Fig. 9. Drawing showing why the guide wire must be inserted to the articular surface of the head.

head point downward because the inclination is upward 15 degrees. The x-ray must be clear, especially in the lateral view and should include all of the head, neck and adjacent shaft. So as not to be confused with the guide wires in the lateral view the Engle May direction finder is slipped through one of them and faces the x-ray cone and tube. The use of any more than two guide wires is apt to be confusing, particularly on the lateral view. It is not necessary to move the involved leg during the procedure. When the lateral view is taken, the casette, enveloped in a sterile pillowcase, is put in line with the femoral neck, the edge being placed against the rib margin and the patient holding his breath when the picture is taken. Films

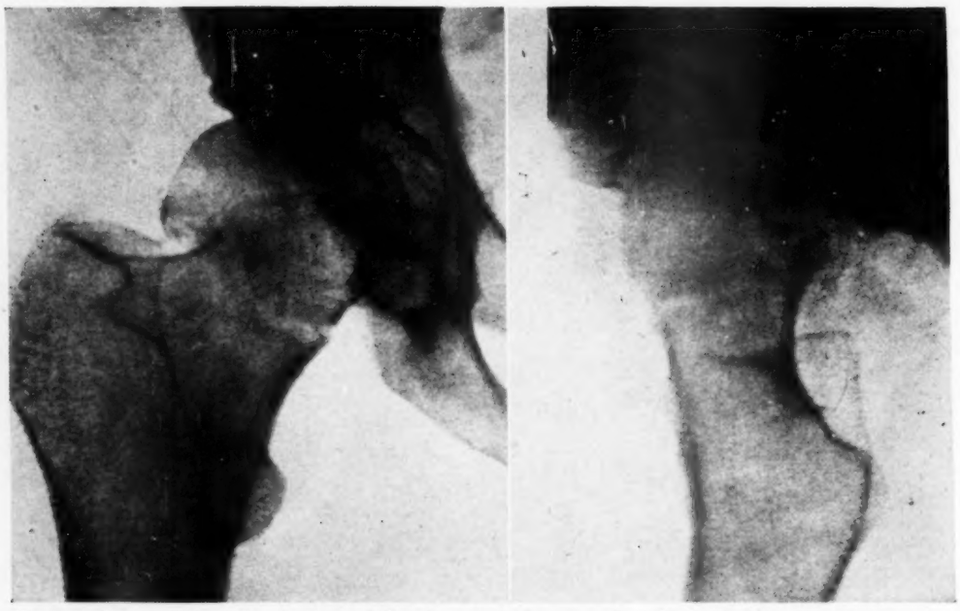

FIG. 10. Illustration showing an abduction type fracture in which pinning is unnecessary.

processed by the portable developer are time-saving but they must be clear. They are not permanent plates. The position should be checked once a month for the first three months, then every two months thereafter. The fracture line must be obliterated, being bridged over by new bone, before weight bearing is allowed. It should be remembered that in order to show all of the femoral neck on the film without distortion the foot must be inverted.

Any operation has its complications. So, also, hip pinning is associated with decubitus, pneumonia and wound infections. These are prevented, if possible, and treated as indicated. The Smith-Petersen pin is a three-flanged nail made of Vitallium. It does not have to be removed unless there is bone infection; then the more quickly removed the better, followed by osteotomy when the process has sufficiently healed. If a small edge penetrates the head slightly, it need only be removed when healing is complete unless this situation causes symptoms. If there are any flaws in the pin, there is apt to be erosion, necrosis and ionization at the site.

Use of the Smith-Petersen pin, as a rule, is attended with excellent results. In 85 per cent of the cases which are pinned, good union is obtained. Barely 40 per cent have good union with the Whitman spica method. In the few cases in which nonunion and absorption result, bifurcation osteotomy or other bone operation must be resorted to. These cases are those that have the pin inserted by opening the capsule to note direction and reduction and those cases in which the blood supply has been markedly interfered with at the time of injury.

SUMMARY

The method is described for the accelerated introduction of the Smith-Petersen pin for fractures of the neck of the femur. This may be divided into different stages.

1. Care of the patient from the time of the accident to operative intervention.
2. Anesthesia, reduction by Leadbetter's method, incision and insertion of the guide wires.
3. The first operative x-rays with one guide wire left *in situ*.
4. Insertion of the cannulated Smith-Petersen pin over the guide wire, the former being driven to a point about ½ inch of the lateral cortex of the shaft and to within ¼ inch of the articular surface of the head.

5. Removal of the guide wire, final x-rays, impaction and closure of the wound.

6. Rules and reasons are given for healing and weight bearing.

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TREATMENT OF HEAD INJURIES AND THEIR SEQUELAE*

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AS Loyal Davis has said: "Craniocerebral injuries are no longer a problem whose solution is reserved for the neurological or general surgeon." It is obvious that in this day and age every physician in every locality will at one time or other be called upon to treat a patient with craniocerebral trauma. The manner in which the patient is treated is all important and while frequently determining survival or decease of the patient, always determines his future value to society. The occurrence of the post-traumatic concussion syndrome is all too frequent, is disastrous to family and industry and is almost always avoidable, or if already present, curable.

Skull fractures are unique among fractures of other bones of the body in that the fracture itself is usually relatively unimportant. The damage to the underlying brain demands primary consideration. An exception to this statement is the compound, comminuted or depressed fracture when débridement or elevation must be performed as soon as the patient's general condition will permit it. Obviously no set regimen of therapy is applicable to all cases of a given descriptive mold and it follows that each patient must be carefully individualized. For therapeutic purposes, however, some classification is desirable and is best made, in my opinion, on the varying degrees of severity of brain damage. The first subdivision would obviously be the presence or absence of subsequent unconsciousness. Inasmuch as the physician rarely sees a patient initially who has not been rendered *unconscious* from a head trauma, we will pass over this division and consider it later with the postconcussion syndrome, which condition it is capable of producing. We can now consider the remaining subdivision, i.e., the head injury which has been severe enough to produce unconsciousness. By and large, the degree of cerebral trauma is in direct ratio to the length and depth of unconsciousness. The length may vary from a few minutes to several weeks. For descriptive purposes we can further subdivide the unconscious patients into categories of cerebral concussion, contusion and laceration in the order of severity. Cerebral concussion has been defined as a state of altered consciousness that occurs in association with sudden acceleration or deceleration of the brain, or a disturbed physiologic state for which there can be found no definite anatomic substratum or at most minimum cellular alterations. Loyal Davis has described it as a mechanical derangement of molecules within nerve cells. It is common knowledge that a sufficiently severe blow on the head may produce a concussion from which a person will die without there being any associated skull fracture and in many of these cases neither macroscopic nor microscopic examination has produced sufficient evidence of the cause of death. In most of these cases, however, there is edema of the brain tissues. When even the latter cannot be demonstrated, it must be assumed that the resulting molecular shake-up of the neuronic cytoplasm produces some chemical change in the nerve cells which is sufficient to interfere with the conduction of the nerve impulse.

In uncomplicated cerebral concussion a diagnostic lumbar puncture will reveal a clear spinal fluid under normal or increased pressure.

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Before proceeding to a definition of the more severe degrees of craniocerebral trauma it might be well timed to consider the contracoup type of injury. This injury, which is by no means infrequent, is seen at the pole of the brain which is diametrically opposite to the primary site of injury. The chief lesion at the site of a contracoup injury is subarachnoid hemorrhage, and also there are usually small pericapillary hemorrhages and edema of the underlying cortex. Cerebral contusion implies a bruised brain, with moderate bleeding into the subarachnoid space and a normal or increased spinal fluid pressure. Cerebral laceration implies a torn brain, with gross bleeding into the subarachnoid space and almost invariably a considerably elevated spinal fluid pressure.

A type of cerebral laceration in which there is bleeding into the substance of the brain will produce a softening which will favor the subsequent occurrence of rather massive hemorrhages. These may cause death in a patient who has survived the initial traumatic laceration, or may form traumatic cysts by liquefaction of the necrotic brain tissue. These complications are more common in children and may simulate true porencephalic cysts which are of developmental origin. Traumatic cysts, however, are not lined by ependymal epithelium. It follows then that the color and pressure of the spinal fluid are important clues to the extent of brain damage and a diagnostic lumbar puncture should never be omitted in a patient unconscious from a craniocerebral trauma. All three degrees of cerebral trauma are accompanied by a greater or lesser degree of cerebral edema. Cerebral edema is due to an increase of tissue fluids within the brain. It is recognized macroscopically by increase in brain volume, convolutional flattening, increase in the volume of white matter, narrowing and compression of the gray matter, ventricular compression and possibly ventricular shift. Microscopically, brain swelling and edema are characterized by hydration and swelling of the axis cylinders, myelin sheaths and glial cells, distention of the perivascular and pericellular spaces, congestion and engorgement of the capillaries and veins, ameboid degeneration of the astrocytes, endothelial necrosis and liquefaction of the nervous tissue. The edema is presumably due to the transmitted force of the trauma causing vasoparalysis of the capillaries and venules, thus producing an increased venous pressure and an actual reversal of the normal direction of fluid exchange. A local accumulation of carbon dioxide resulting from this will lead to further vascular dilatation and increased permeability of the vessel wall. The developing edema further retards circulation and a vicious circle is formed.

If the aforementioned facts are borne in mind, the rationale of the dehydration treatment of craniocerebral trauma will readily be appreciated.

Treatment of a patient suffering from a craniocerebral trauma resolves itself first into the treatment of shock, if it is present, and secondly, into management of the brain damage itself.

Since the treatment of shock is well known, we will only state that the currently popular product used to combat shock, viz, blood plasma, is the best cerebral dehydration agent we know of, being far superior to hypertonic solutions of dextrose or sucrose. After the shock is under control and all bleeding has stopped a cursory neurologic examination is in order. The size, equality and reaction of the pupils to light should be noted. A dilated pupil, fixed to light is frequently present on the side of maximum injury or bleeding. The escape of blood or spinal fluid from the orifices is frequently indicative of a basilar fracture. The state of the abdominal reflexes plus the sign of Babinski will often determine the side of maximum damage. In a case of severe concussion, contusion or laceration it is not unusual to find bilateral pyramidal tract signs. The relationship of the pulse pressure to the pulse rate is of significance. When the former exceeds the latter, it is a grave sign and decompression either medi-

cally or surgically is indicated. A skull ray is very valuable and should be taken provided that adequate x-ray facilities are available and it does not require rough handling of the patient. The next step is a diagnostic (and sometimes therapeutic) lumbar puncture. This procedure should never be attempted unless the patient is quiet. If he is delirious or unmanageable sodium luminal in doses of 2 to 6 gr. hypodermically, or sodium amytal gr. 3¾ intravenously may be given and the puncture done after the drug has taken effect. While taking the initial pressure, the patient's head should *not* be bent forward as this increases the pressure. The Queckenstedt test should never be performed while doing a spinal puncture on a patient suffering from a craniocerebral trauma. It adds no useful information and may actually be dangerous if the spinal fluid pressure is elevated since it favors medullary herniation. The normal spinal fluid initial pressure is between 100 and 200 mm. of water. If it is above 200 mm., enough fluid should be withdrawn slowly to reduce the initial reading 50 per cent or more. If the patient coughs or strains during the procedure, the stylet should be replaced and the physician should wait a few minutes before withdrawing any more fluid. The fluid, if bloody, should be kept on the floor to be compared with subsequent specimens. The frequency of lumbar punctures will depend upon the patient's general condition, height of the spinal fluid pressure, amount of blood in the fluid and the rate at which fluid limitation and administration of dehydrating agents can reduce the brain swelling. Almost never is it necessary to tap a patient more than twice a day and after twenty-four to thirty-six hours once a day should be adequate. Even after the spinal fluid pressure has stabilized at a normal or subnormal value, lumbar puncture should be performed daily or every other day as long as the fluid is bloody. Daily lumbar puncture is warranted from the symptomatic standpoint alone, not only in subarachnoid hemorrhage of traumatic origin but also in spontaneous subarachnoid hemorrhage since many patients are greatly relieved of their headaches following the puncture. If a patient is limited to as little as 750 cc. of fluid in twenty-four hours, he will not make any spinal fluid and after two or three days you will encounter a dry tap. The only traumatic condition in which lumbar puncture is dangerous is massive intraventricular hemorrhage and this condition is usually fatal in itself. The value of lumbar puncture on the other hand, not only diagnostically but therapeutically, can readily be appreciated when one considers that of all the intracranial contents, the subarachnoid, cistern and ventricular fluid is the only component which is unnecessary for normal brain function, at least under the conditions in which one would find a patient unconscious from a craniocerebral trauma. The subject of lumbar puncture has been discussed at some length to dispel the current naive fear of this valuable and frequently life saving procedure.

To further reduce cerebral edema the employment of hypertonic solutions intravenously is used. As previously mentioned blood plasma is the best and may be administered in quantities of 250 to 300 cc. at eight-hour intervals. If this is not available, 50 to 100 cc. of 50 per cent sucrose or sorbitol is next preferred or, if unavailable, the same quantity of dextrose at four to six-hour intervals. The employment of hypertonic intravenous dehydrating agents are of most value when given early and become less important after twenty-four to thirty-six hours since by this time the fluid limitation itself has begun its function of dehydration. Oral administration of dehydrating agents also has its place in reducing cerebral edema and may be employed as soon as the patient has responded and is able to swallow. The drugs we prefer are magnesium sulfate crystals, ounces 1½ in ½ a glass of water, or Fleets phosfo-soda, drams 6, in the same amount of water. We prefer not to repeat this more often than once daily since the resulting catharsis is rather exhausting. Temple Fay has ad-

vocated a fluid restriction of 750 cc. per twenty-four hours. We believe this is too drastic a limitation since some of our patients have developed an alarmingly high blood non-protein nitrogen on this regimen. We rarely limit the fluids to less than 1,000 cc. per twenty-four hours, and while a small amount of cerebrospinal fluid will be formed it is insufficient to raise the intracranial pressure. The fluid limitations should be observed for several weeks since we have found that the post-concussion syndrome is much less likely to occur than when unrestricted fluids are allowed with the regaining of consciousness. The triad of lumbar puncture, intravenous administration of hypertonic dehydrating solutions and fluid restriction is the warp and woof of the dehydration treatment of craniocerebral trauma and has saved untold numbers of lives.

To pass from specific therapy to general therapy we may first discuss the position of the patient. If the patient is not in shock, the ideal position is one of semi-Fowlers. The intracranial pressure is slightly lower in this position and there is less intracranial bleeding. Care should be taken that the patient has an adequate air way at all times. Suctioning the pharynx of mucous, blood or vomitus and keeping the tongue from falling back due to weakness of the pharyngeal muscles by either turning the patient's head to the side and pulling the tongue out, or by using an airway will insure adequate aeration. Proper consideration must also be given the bladder. A violently delirious patient can sometimes be made as docile as a lamb by the simple measure of catheterization. A wet bed is no guarantee of an empty bladder and, when in doubt, catheterization for residual urine should be carried out. Bleeding or dripping of spinal fluid from the ear is best managed by cleansing the external auditory meatus with sterile cotton and then placing a sterile cotton pledget moistened with alcohol loosely in the meatus. This is changed frequently. These patients should receive 1 Gm. of sulfadiazine four times daily prophylactically for approximately a week to avoid the complication of septic meningitis. Penicillin offers no advantage over the sulfa drugs for this prophylaxis.

The feeding and maintenance of a fluid balance in an unconscious patient, while not peculiar to head trauma cases, is perhaps more frequently met with under these circumstances. Patients unable to take fluids orally may be given intravenous infusions of 10 per cent dextrose in sterile distilled water. This solution has a small caloric value and avoids the sodium ion thereby discouraging tissue fluid retention. Fifty per cent glucose may be used both for nourishment and dehydration. The injectable amino acids, such as parenamine, may be given in quantities of 100 or 200 cc. in 500 to 750 cc. sterile distilled water with or without 5 per cent glucose intravenously twice daily. If the unconsciousness lasts more than a day or two, the best procedure is to insert a Levine tube and administer fruit juices, egg nogs, etc. Medications, such as pyramidon in 10 gr. doses, may be given through the tube to combat an alarming hyperthermia. The latter condition may also be treated by applying ice caps to the axillae and groin and also by ice water enemas.

The sedative drugs to be used are codeine, by mouth or hypodermic in ½ to 1 gr. doses, sodium luminal hypodermically in doses of from 2 to 6 gr. and sodium amytal intravenously in 3¾ gr. doses. All these may be repeated in from two to six hours. Morphine, pantopon or dilaudid are never given to patients with head injuries since they depress the respiratory center, increase cerebral edema and mask the degree of consciousness. We have used demerol in doses of 50 to 100 mg. orally or hypodermically in a few cases without observing any deleterious effects.

The period of bed rest is another problem which must be individualized, but it is a good rule to keep patients in whom a fractured skull has been demonstrated or those who have suffered a period of unconsciousness at absolute bed rest for a minimum

period of three weeks. Not all of this time is necessarily spent in the hospital.

Recently there have been reports from various physicians who have returned from service in the armed forces to the effect that the sooner a patient who has suffered a craniocerebral trauma can be gotten out of bed and up and around the less likely he is to develop a postconcussion neurosis. While this view may be true in cases of head injuries received in military service, I cannot subscribe to it on the basis of my experience in civilian neurosurgery.

When expected recovery from a craniocerebral trauma in a reasonable length of time under intelligent management is not realized, it is assumed that the general practitioner, general surgeon or neurologist will seek consultation with a neurologic surgeon. In case the failure to recover is due to a subdural hematoma or hydroma the neurologic surgeon can be a life saver if not a mind saver.

Subdural hematoma is a frequent and far too often unrecognized complication of head injury. The bleeding is usually venous and therefore slow and often intermittent. The time interval between the receipt of the trauma and the onset of symptoms is from a few days to many months. Inasmuch as a subdural hematoma takes a rather flat saucer shape its pressure over any particular area of the brain is frequently insufficient to cause objective neurologic signs of lateralizing or localizing value. Instead, mental hebetude, changes in personality and intractable headache with frequent blurring of vision are the most common symptoms. Not few patients are confined within the walls of mental hospitals with psychiatric diagnoses who in reality have subdural hematomas, nor is the trauma which is capable of producing subdural hemorrhage always a direct blow to the head. A man firing a shotgun may bleed subdurally from the violent throwing back of the head when the gun recoils. In elderly patients the most trivial and therefore easily forgotten trauma is capable of producing this serious complication. A careful neurologic examination may lateralize the lesion, but often it is bilateral and one must resort to encephalography or exploratory trephination. The prognosis of this condition depends, of course, upon the size and locality of the clot and the time interval before its recognition and subsequent drainage. As a general rule the prognosis is good providing the preceding cerebral edema and laceration have not irrevocably damaged the brain. The treatment is surgical drainage which rarely requires more than a trephine opening drilled up to a number four bit. As soon as the dura, which is dusky blue in color and many times its normal thickness, is incised the liquid portion of the clot will not infrequently spurt out a few feet. The clotted portion is washed out with warm saline solution. It is not necessary to remove the capsule enveloping the clot. The results following drainage are often dramatic and many times it has been my experience to have the patient recover consciousness while still on the operating table when local anesthesia only has been used. It is best to drain subdural hematomas for at least forty-eight hours, forcing fluids in the meantime.

Subdural hydromas or hygromas, which are lakes of cerebrospinal fluid encapsulated in the subdural space, said to be formed by a small rent in the arachnoid membrane allowing escape of fluid into the subdural space but not its return to the subarachnoid space, present, in general, the same symptomotology as their cousin subdural hematomas but fortunately are far less frequent since, in general, the prognosis following surgical drainage of these lesions, which for some reason is not clear, is far less favorable.

An epidural or extradural hemorrhage, unlike a subdural hemorrhage, is produced by arterial bleeding, most frequently from the posterior branch of the middle meningeal artery. Linear fractures of the squamous temporal bone are prone to be followed by this most fatal complication. The epidural hemorrhage, again differing from

the subdural hemorrhage, takes a distinctly globular form so that localizing neurologic objective signs develop rapidly. The time interval between the receipt of injury and the onset of symptoms is much shorter and usually is only a matter of an hour or two. The injury usually, but not always, is followed by a momentary period of unconsciousness, to be followed by a lucid interval, which in turn is followed by increasing drowsiness, severe headache, vomiting and ultimately unconsciousness. As a rule lateralizing signs develop quickly. A fixed dilated pupil and a contralateral Babinski will indicate the side on which bleeding is in progress. The spinal fluid is usually clear and under greatly increased pressure. Prompt surgery must follow if the patient's life is to be saved. In most cases if more than six hours elapse between the onset of symptoms and surgical intervention, the mortality rate is 100 per cent and even with prompt operative interference the death rate is better than 30 per cent. It is necessary to perform a generous subtemporal decompression in these cases inasmuch as it is imperative that the bleeding point be found and stopped, either by compression, coagulation, silver-clipping or suturing a piece of macerated muscle over it or by a combination of all these measures. The prognosis, in the event the patient survives, is usually excellent inasmuch as the pressure of the hematoma while sudden and considerable is too evanescent to be followed by irrevocable cerebral damage.

Meningitis is an occasional complication of a compound skull fracture of the cranial vault or a basilar fracture accompanied by otorrhea or rhinorrhea. Any one or several of the common pyogenic cocci are the usual invading organisms. A marked hyperthermia, accompanied by cervical rigidity and a positive Kernig sign should make one extremely suspicious of meningitis, but it must be remembered that a considerable amount of bleeding into the subarachnoid space will also produce these phenomena. Withdrawing a specimen of spinal fluid for a cell count, smear and culture will clinch the diagnosis. When the diagnosis has been established or strongly suspected, massive doses of the sulfa drugs must be administered, such as 5 Gm. of sodium sulfadiazine in 500 cc. of normal saline solution intravenously, to be repeated every eight hours. This mode of administration can then be supplemented or entirely replaced by the oral administration if the drug can be tolerated by that route. One should strive to maintain a blood-sulfa level of 18 or better until the spinal fluid cell count is normal or the culture negative. We have been less impressed with the efficacy of penicillin in the pyogenic meningitides, but the latter may be given in doses of 30,000 units intramuscularly every three hours, or as a continuous intramuscular drip of 120,000 units in 500 or 1,000 cc. of saline solution over a twelve-hour period. In very serious cases one may tap the cisterna magna of 20 to 30 cc. of cerebrospinal fluid and inject 15,000 units in 10 cc. of normal saline solution. In these cases one must avoid overhydration of the brain and keep the total fluid intake at or under 2,500 cc. per twenty-four hours.

Osteomyelitis, epidural abscess and brain abscess are rare complications of cranial trauma, being more often preceded by suppurative sinusitis or otitis media. The first of these conditions may be recognized by local redness, tenderness and tumefaction plus *x*-ray examination while the latter two are characterized by increasing headache, mental hebetude, fever, leukocytosis, elevated spinal fluid pressure and possible localizing neurologic signs. Their ultimate detection and treatment taxes the skill of the most discriminating neurologic surgeon.

The most common sequela of craniocerebral trauma is referred to as the postconcussion syndrome. It is usually characterized by a trinity of subjective symptoms which are headache, dizziness, noticed especially on sudden changes of position, and emotional instability. Memory loss and poor power of concentration are not infrequent complaints. The objective neurologic

examination is in most instances negative in detail, and it is this fact that makes it most difficult to prove its existence when testifying in compensation and civil court. Unscrupulous attorneys are well acquainted with this syndrome and will often coach their clients in its symptoms so that many a jury has been sold a bill of goods on an out-and-out malingerer. The infrequency of this complication developing in children would seem to favor the view that there is an underlying functional as well as organic factor present in the syndrome. The only objective sign of any frequency is nystagmus. The occurrence of the syndrome seems to have no relationship whatever to the severity of the preceding trauma, and I have observed it following such minor blows to the cranial vault as the falling of a venetian blind, following which the patient was not even stunned, much less unconscious. It may make its appearance weeks or months after the trauma. The histopathologic changes underlying the condition are poorly understood. Penfield ascribed the condition to the development of subdural adhesions. Malone recently has brought forth convincing evidence that the syndrone arises from an alteration of vasomotor tonus of the meningeal vessels. The affection is most frequently acquired by emotionally unstable individuals who have been improperly treated from the start. The observance of an adequate period of absolute bed rest and adherence to a strict dehydration regimen are the best assurances against the subsequent development of this troublesome and economically disastrous syndrome. Inasmuch as the symptoms are intensified by overhydration, one may start treatment by moderate fluid restriction, omission of salt in the diet, small doses of sedative drugs, limitation of physical and mental activity and reassurance. If after a few weeks the symptoms still persist, one may give 1 cc. of a solution of 1:2,000 prostigmine methylsulfate intramuscularly twice weekly, and one 15 mg. tablet of prostigmine bromide three times daily for several weeks. I have observed some very dramatic cures of the syndrome following this treatment. If symptoms still persist after a fair trial of prostigmine, a therapeutic encephalogram is justified. This procedure has the double purpose of severing subarachnoid adhesions and occasionally demonstrating the existence of an unsuspected subdural hematoma or hydroma which could cause the persistence of symptoms. I have repeatedly had the experience of encountering a sudden gush of blood-tinged or xanthochromic spinal fluid while performing an encephalogram when the previous 70 to 100 cc. were crystal clear. This is evidence that subarachnoid adhesions producing a loculation of fluid exerting localized meningeal pressure and irritation have been broken up, thus draining the hydroma. Therapeutic encephalography will usually relieve about 80 per cent of the cases of postconcussion syndrome which have been refractory to other methods of therapy. Occasionally, therapeutic encephalography must be repeated in order to effect a complete and lasting cure. Rarely a severe secondary or even primary anemia following head trauma will mask itself as a postconcussion syndrome. A red count and hemoglobin determination should be done on all patients complaining of chronic headache.

Cases of severe concussion are not infrequently followed by cerebral atrophy, either of the cortex, the white matter or of both. These conditions are well demonstrated by encephalography. Cortical atrophy is characterized by widening of the sulci and large collections of air at the frontal or occipital poles while atrophy of the white matter produces symmetrical enlargement of the lateral ventricles and sometimes even of the third ventricle as well. The dilatation is never as extensive as is found in cases of obstructive hydrocephalus. Mental deterioration may follow cortical atrophy, especially when it involves the frontal poles. Administration of saturated solution of potassium iodide, minims x three times daily, has appeared

to help some of these patients but I do not place much faith in it.

One of the most distressing sequelae of craniocerebral trauma is post-traumatic epilepsy. This condition may develop several months or years after receipt of the trauma, and the convulsion may be localized or generalized, with or without accompanying unconsciousness. The cause of the spells is due to a cortical scar which pulling on the vaso-astral framework acts as an irritative focus and spreads the epileptic impulse. The scar is comprised principally of astrocytes (the principal supporting cell of nervous tissue) and therefore is relatively tough and may pull an adjacent ventricle toward it by contraction. This phenomenon likewise can be demonstrated by encephalography. Occasionally, local excision of a cortical scar is followed by a decrease in the number, severity and duration of convulsive seizures. Of course, surgical excision of a scar is followed by another scar but this scar is made up primarily of oligodendrocytes, instead of astrocytes, and therefore is softer and less liable to distort the vaso-astral framework and give rise to an epileptic impulse. It is this fact, demonstrated by Penfield, which led him and his co-workers to advise local excision of cortical scars after electrical stimulation of the scarred area produced convulsive movements which resembled the original seizures. Their results, while by no means universally successful, have been sufficiently encouraging to warrant a trial of this method when more conservative measures have failed. Therapeutic encephalography again may be of great value in this condition by separating arachnoidal adhesions overlying the cortical scar. If this fails, recourse may be had to the usual anticonvulsant drugs, such as dilantin sodium, with or without phenobarbital, or phenobarbital and manganese dioxide. The electroencephalogram has proven invaluable in differentiating between essential convulsive disease (or genetic epilepsy) and traumatic epilepsy. It has been our custom to submit all patients with convulsive disease to electroencephalography and if the latter tracing shows a focalizing or lateralizing area we then submit the patient to air-encephalography. If no focus is demonstrated, we then send the patient back to the referring physician for anticonvulsant drug therapy.

In this paper I have made no pretense of thoroughly covering all aspects of craniocerebral trauma. It has been written primarily for the physician or surgeon who is not himself a neurologist or neurologic surgeon. It is sincerely hoped that it will counteract the "therapeutic nihilism" which was in vogue a decade ago in regard to craniocerebral trauma when a popular slogan for a patient suffering from a head injury was: "Put him to bed in a dark room and leave him alone." Under this indolent and pernicious regimen the mortality rate of patients suffering from cerebral injury often rose to 40 per cent or higher. With the management as outlined in this paper, the mortality rate should vary between 18 and 21 per cent. This is a goal well worth working for.

ACUTE INTUSSUSCEPTION IN INFANCY AND CHILDHOOD*

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ACUTE intussusception is the most frequent cause of intestinal obstruction in infancy and childhood and second only to appendicitis as the cause of the acute surgical condition of the abdomen in the same age group. The obstruction produced is invariably of the strangulation type if persistent for any period of time and has carried a distressing mortality through the years.

During an eleven-year period (1936 to 1947) pediatric admissions to the University Hospital and the Nebraska Methodist Hospital were reviewed to note the incidence of intussusception in this area. In 12,288 infant and child admissions from all causes to both institutions twenty patients with intussusception were found, an incidence of .16 per cent. On the University Hospital service, which is an entirely charitable institution, there were seven cases in 3,929 admissions, an incidence of .17 per cent. In the 8,359 private admissions to the Nebraska Methodist Hospital there were thirteen cases giving an incidence of .157 per cent. These figures are of interest since they indicate that numerically intussusception is not common and no single individual in this area of the country will personally see any sizable series of patients. This is undoubtedly a factor of importance when a diagnosis must be made in an atypical case.

Intussusception is apparently seen with a much greater frequency of occurrence in other sections of the world, namely, in Britain and Australia. In this country Ladd and Gross[1] in Boston report their incidence as .3 per cent in 121,515 children's admissions while Gordon[2] in New Haven noted an incidence of .032 per cent in 133,326 general admissions of all ages. All authors agree that patients are seen with equal frequency on private and charity services.

In Table I representative series of cases published from 1907 to the present have been tabulated. Boys are affected more often than girls in the approximate ratio of 65:35. Intussusception is essentially a disease of the first two years of life, the vast majority of the patients being seen between six to eighteen months of age. (Table II.)

A number of etiologic factors have been observed and suggested for intussusception. These include Meckel's diverticula, polyps or new growths which are said to occur in from 4 to 8 per cent of recorded cases.[15,16] In addition to these factors, inflammed lymph tissue acting as a polyp,[9] defects in the structural arrangement of the splanchnic nervous system and irregular action of the intestinal musculature with spasm of the circular coat have all been suggested as possible causes.[4,17] Attention has been called by Power to the disproportionate growth of the colon and ileum in infancy, both being approximately the same size at birth.[18] Meckel's diverticula were present in two and a polyp of pancreatic tissue in one of our twenty cases, an incidence of 15 per cent. It must be accepted today that in the absence of some specific lesion, such a polyp or diverticulum, the etiology is unknown.

For practical purposes intussusception is seen in three main forms: enteric, colic and enterocolic. From a pathologic standpoint they may be further classified. (Table III.)

True colic intussusception is rare in

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infancy and childhood, being encountered principally in elderly individuals with polypoid lesions of the colon. Enteric or ileo-ileal lesions are seen more frequently and present distinct problems. This type of intussusception tends to begin and progress slowly, producing mild symptoms at first which are not typical of the ileocolic lesion. Perrin and Lindsay[7] noted a palpable abdominal mass in only eight of their twenty-seven enteric cases, which on the average came late to surgery with a mortality of 55 per cent for the group. They conclude that the type of intussusception with the milder symptoms is ultimately the most fatal. In our own small series of twenty cases three were of the enteric type and in each it was possible to palpate an abdominal mass. Two of these three patients survived, one necessitating a resection.

The enterocolic form of intussusception is the most common one encountered, beginning in the distal 10 to 15 cm. of the ileum and proceeding to the distal portion of the colon. In an effort to expel the abnormal bolus within the bowel the intussusceptum is pushed further and further along the colon until it may become palpable by rectum or protrude through the anus. Ladd and Gross[1] were able to feel the intussusceptum in 29 per cent of their series of patients upon rectal examination and in four patients it had prolapsed through the anus on admission. Gibbs and Sutton[14] record rectal examinations in sixty-eight of their ninety-two patients, the intussusceptum being palpable in 41.2 per cent of those examined.

The classical symptom complex produced by a typical ileocolic intussusception is well appreciated today. Diagnosis is not difficult in the usual case with dramatic onset, recurrent paroxysms of pain with intervening periods of comfort, development of an abdominal mass and the passage of blood with mucous per bowel. It is the atypical case that offers the more difficult problems in these young patients and the two conditions most likely to be confused are appendicitis and acute enterocolitis.

In general, appendicitis is uncommon under the age of two. Its onset is neither so

TABLE I

COLLECTED SERIES OF INTUSSUSCEPTION IN INFANCY AND CHILDHOOD

Author	Year	Cases	Male %	Female %	Specific Cause Found	Bloody Stools %	Palpable Mass %	Treatment				Deaths	Per Cent Mortality
								Enemas	Reduction	Resection	Other Procedures		
Hess	1905	1,020 collected	...	...	..	...	..	151	549	109	211	513	50.2
Clubbe	1907	114	...	...	..	94	..	138	124	8	...	40	33.2
Romanis	1918	374	...	...	10	...	..	...	331	30	13	121	32.3
Lanman	1921	72	...	...	..	...	..	...	72	...	...	30	41
Perrin and Lindsay	1922	400	64	36	..	...	..	...	327	31	42	139	34.7
Harper	1922	112	63	37	..	...	..	...	112	...	...	44	39.2
Wade	1924	519	297	147	..	...	..	...	...	...	...	73	14.06
Miller	1933	20	...	...	2	100	..	...	18	2	...	9	45
Ladd and Gross	1934	372	61	39	..	...	84	...	308	30	...	...	59 (1st 5 yr.) 27 (1st 20 yr.) 14 (last 5 yr.)
Barrington-Ward	1936	88	65	35	..	84	..	...	...	...	...	...	20.4
Gordon	1940	43	...	...	3	90	77	...	44	...	...	10	23
Kahle	1941	151	...	...	15	...	..	...	116	27	8	...	52 30.5 (last 10 yr.)
Mayo and Woodruff	1941	55	...	...	..	...	..	...	44	5	6	13	23.6
Gibbs and Sutton	1943	92	62	38	..	71	64	...	77	7	8	28	30.4
McLaughlin	1947	20	57	43	3	86	76	...	15	1	1	5	23.8

sudden nor as dramatic and vomiting with associated abdominal tenderness, muscle guard and distention are more apt to be presenting symptoms.

Acute enterocolitis may be extremely difficult to differentiate and in the absence of an abdominal mass the picture is even more complex. One such infant, six months of age, was admitted to the pediatric service at the University Hospital with bloody diarrhea and insignificant abdominal findings. It succumbed a few hours after admission, the clinical diagnosis being acute fulminating enterocolitis. At postmortem examination a gangrenous ileocolic intussusception was found. In such instances in which any question may exist use of a diagnostic barium enema is certainly indicated. Williams[19] has recently urged a wider employment of this procedure in all questionable cases, both for purposes of diagnosis and as a therapeutic aid prior to surgical reduction.

Table II
OCCURRENCE OF INTUSSUSCEPTION ACCORDING TO AGE GROUP

Author	Cases	Under 1 Yr. %	Under 2 Yr. %	Youngest	Oldest
Perrin and Lindsay...	400	69	78		
Ladd and Gross.....	372	70	87	17 days	11 yr.
Kahle.....	151	50	59		
Gibbs and Sutton....	92	61.5	..	2 mo.	15 yr.
Mayo and Woodruff..	55	65	80		
Gordon.....	43	....	83		
McLaughlin	20	75	95	4 mo.	5 yr.

Table III
TYPES OF INTUSSUSCEPTION ACCORDING TO PATHOLOGY

Type	Author		
	Ladd and Gross 372 Cases %	Rohan %	McLaughlin 20 Cases %
Enteric.....	7	10–15	20
Colic.....	2	5–10	0
Enterocolic.....	75	75–80	75
ileo-ileocolic.....	9		
ileo-cecocolic....			
Multiple.....	.8	.....	5
Retrograde.....	.3		

Aside from volvulus the only other conditions likely to be confused with intussusception are rectal prolapse and abdominal purpura. The first is readily differentiated by a rectal examination while the second may be identified by the finding of petechiae on the body, a tourniquet test and blood studies.

It is generally conceded that surgical reduction is the proper method of treatment for intussusception as soon as the diagnosis is clinically established. Throughout the years there have been those who favored the use of enemas as an alternative to surgery, but the inherent risk of incomplete reduction has gradually placed the treatment of these small patients in the hands of the surgeon. It cannot be said that an enema given before surgery is without value for it often may greatly reduce the manipulation required by the surgeon when open reduction is undertaken. The risk lies in postponing surgery with the belief that the intussusception has been relieved when in reality the small initial intussusceptum has remained unreduced.

Surgical technic in the usual case has become quite standardized.[21] A right rectus muscle splitting or paramedian incision of sufficient length to permit the introduction of a hand is made and the advancing head of the intussusceptum in its ensheathing bowel is located within the abdomen. The intussusception is then reduced within the abdomen, using the two index fingers until only the original portion remains unreduced. Then this is usually delivered outside the abdomen for the final reduction under direct vision. In the usual ileocolic type one rarely encounters great difficulty in the preliminary reduction. We have on occasion experienced some difficulty in negotiating the splenic flexure of the

colon in some of these infants. The final reduction at the cecum may be extremely difficult due to marked edema of the bowel. Ladd's[15] suggested maneuver that the bowel be wrapped in moist towels and submitted to gentle pressure for a period of several minutes is one of real practical merit. In the last ninety patients coming to surgery Ladd and Gross[1] found it necessary to resect only twice and they attribute this remarkably low incidence to (1) earlier diagnosis: (2) more boldness in completing reductions on patients that previously would have been considered irreducible and (3) better appreciation of the viability of contused, hemorrhagic and edematous bowel after reduction.

In our series of twenty cases two were found at operation to have undergone spontaneous reduction, their being a hemorrhagic terminal ileum and cecum as evidence of the previously existing lesion. Ladd and Gross[1] report sixteen such instances in their series of 373 cases.

Most surgeons today are not impressed with the various procedures of bowel fixation devised to prevent a recurrence of an intussusception and these are not commonly employed. The same may be said for the performance of an appendectomy even though this structure may appear quite edematous and hemorrhagic. Goldman and Elman,[22] however, have recently reported five cases of acute recurrent intussusception occurring in older children in whom spontaneous reduction had occurred after one or several acute attacks. They collected thirty similar cases from the literature and recommend appendectomy to produce adhesions and prevent recurrences if such a case be explored.

When an irreducible intussusception is encountered, one is confronted with a much more serious technical problem. The patient will usually be found to be present with an enteric intussusception, an ileocecal or ileocolic invagination, coming very late to surgery, or one of the multiple types with associated enteric and ileocolic lesions. When confronted with such a problem, four types of operative procedures have been employed with sufficient frequency to draw some conclusions. These are: (1) resection with immediate anastomosis, either end-to-end or side-to-side; (2) exteriorization or some modification of the Mikulicz procedure; (3) lateral anastomosis about the intussusception; (4) Maunsell's operation; (Jessett-Barker) resection of the intussuscepted mass through a longitudinal incision in the outer sheath of the intussusception followed by closure of this incision and tacking the junction of the entering bowel and the neck of the intussusception.

In Table IV a compiled series of 200 cases of irreducible intussusception are tabulated. These cases reported from 1907 to the present time indicate that intussusception is found to be surgically irreducible in approximately 12.4 per cent of the reported cases.

Resection with immediate anastomosis was first successfully performed for irreducible intussusception in an eleven month old infant in 1907.[4] In the same year Collinson[23] successfully resected the terminal ileum and ascending colon in a three month old infant using a Mayo-Robson button at the line of anastomosis. Since 1907 reports of ninety-nine resections have been collected with an overall mortality of 67.8 per cent. It is interesting to note that the mortality following resection has dropped from 84 per cent (thirty-two cases) in the period from 1907 to 1917 to thirty-nine per cent (forty-eight cases) in the decade from 1937 to 1947.

Resection of the gangrenous lesion by a modified Mikulicz procedure has been the second most commonly employed procedure. Its principal and obvious disadvantage is the resultant ileostomy which is poorly tolerated even for short periods of time in infancy. Ladd and Gross[1] report only one recovery in fourteen patients when using this technic while Gibbs and Sutton[14] had no recoveries in seven patients treated by this method. Hindmarsh et al.[41]

TABLE IV

COMPILED SERIES OF IRREDUCIBLE INTUSSUSCEPTIONS. SURGICAL PROCEDURE

Author	Year	Total Cases	No. Irreducible	Resection and Anastomosis				Maunsell's Procedure			Lateral Cases	Anastomosis		Colostomy or Mikulicz's Procedure			Mortality in Irreducible Cases Per Cent
				Per Cent	Cases	Deaths	Per Cent	Cases	Deaths	Per Cent		Deaths	Per Cent	Cases	Deaths	Per Cent	
Clubbe	1907	127	8	6.3	8	7	87	..	..	...	..	..	.....	..	..	.....	87
Collinson	1907	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Coffey	1907	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Rutherford	1909	....	7	....	3	3	100	2	2	100	2	1	50	..	..	.....	86
Parry	1909	...	1	....	...	..	.....	..	..	...	1	0	0	..	..	.....	0
Dowd	1912	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Eccles and Laidlow	1912	89	9	10	9	9	100	..	..	...	..	..	.....	..	..	.....	100
Koch and Oerum	1912	400	8(?)	....	8	8	100	..	..	...	..	..	.....	..	..	.....	100
Eisendrath	1915	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Southam and Cranshaw	1921	...	2	....	2	0	0	(one resection done below anus)					.....	..	..	.....	0
Perrin and Lindsay	1922	400	53	13	47	38	79	..	..	...	..	..	.....	6	6	100	83
Montgomery and Mussil	1930	...	2	....	...	..	.....	..	..	...	2	0	0	..	..	.....	0
Ladd and Gross	1934	372	33	9	16	15	93	3	3	100	..	..	.....	14	13	93	94
Elliott-Smith	1935	...	4	....	1	0	0	..	..	...	3	0	0	..	..	.....	0
Stuppel	1939	...	1	....	...	..	.....	..	..	...	1	0	0	(Subsequent Resection)			0
Greenberg	1939	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Forty	1940	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Mayo and Woodruff	1941	55	8	14.2	5	2	40	..	..	...	3	0	0	..	..	.....	25
Laycock	1941	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Kahle	1941	151	33	22	27	13	48	2	2	100	2	2	100	2	1	50	54.5
Vellacoit	1942	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Gibbs and Sutton	1943	92	15	16.3	7	3	42	..	..	...	1	1	100	7	7	100	73.3
Capone	1944	4	1	25	1	1	100	..	..	...	..	..	.....	..	..	.....	100
Clark	1944	...	1	....	1	0	0	..	..	...	..	..	.....	..	..	.....	0
Fallis and Warren	1945	...	2	....	2	0	0	..	..	...	..	..	.....	..	..	.....	0
Hindmarsh et al	1945	...	2	....	...	..	.....	..	..	...	..	..	.....	2	0	.....	0
McLaughlin	1947	...	2	....	1	0	0	..	..	...	..	..	.....	1	1	100	50
			200		146	99	67.8	7	7	100	15	4	26.6	32	28	87.5	Av. 69

in 1945 reported two successful procedures of this type in children, catheters being placed in each loop at operation. In both cases the spur was crushed six days after resection and the stoma successfully closed on the twelfth day after the original operation. The overall mortality with this technic in thirty-two collected cases has been 87.5 per cent and during the past decade it has remained at 73 per cent.

Rutherford[25] and Parry[26] independently reported the successful management of irreducible intussuceptions by lateral anastomosis in 1909. Subsequent favorable reports have been published by Montgomery and Mussil,[32] Mayo and Woodruff[13] and Elliott-Smith.[33] Parry[26] strongly recommended this procedure for its simplicity, because it provides an alternative line of treatment to prolonged manipulation in irreducible cases and last since the palpable mass tends to disappear in from one to three weeks following lateral anastomosis. This method can only be considered in irreducible cases of the ileocolic type since the sheath in such a lesion usually remains viable. Elliott-Smith[33] records the successful employment of lateral anastomosis in an enteric intussusception, but its use in such a case is hazardous as evidenced by Stuppel's[34] experience. He performed an anastomosis around an enteric intussusception in which the sheath seemed entirely viable. Pain continued with the development of localizing peritoneal signs. Upon reoperation the entire intussusception was found to be gangrenous and was resected with a successful result. Reports of fifteen cases handled by this method have been collected from the literature with an overall mortality of 26.6 per cent. During the past decade seven patients treated by this technic have resulted in a mortality of 43 per cent.

The procedure known under the name of Jessett, Barker or Maunsell has been infrequently employed during the past forty years in the management of these irreducible cases. A very similar, but somewhat more radical procedure, was described by Coffey[24] with its successful employment in one child of seven years. Except for this one reported case, the remaining seven collected patients subjected to this type of procedure all died.

In our series of twenty cases two were found to be irreducible at operation. In one of these an exteriorization procedure was carried out, the infant succumbing with shock three hours after surgery. The second infant, eight months of age with a double enteric and associated ileocolic lesion, was successfully resected with immediate lateral anastomosis.

Since intussusception is essentially a problem affecting infants in the first year of life, it is to be expected that the mortality in all cases, and particularly the irreducible ones, will be highest during this period. Koch and Oerum[29] found only six successful resections for irreducible intussusception in those under one year of age in 1912. Perrin and Lindsay[7] in 1922 reported no survivals in forty-seven children under three years of age who submitted to resection. In 1941 Kahle[12] reported that while his overall mortality was 52 per cent in a series of 150 cases the mortality was 57 per cent in the infant group seen during the first twenty-four hours, 85.7 per cent in the group seen at the end of twenty-four hours and 100 per cent in the group coming for treatment after this period of time.

During recent years the general picture has improved and increasing numbers of successful surgical procedures in irreducible cases are being reported. From a technical standpoint this improvement is probably due to improved anesthesia, greater appreciation of the importance of maintaining these small patients' body heat and expediting the operative procedure.

SUMMARY AND CONCLUSIONS

1. Intussusception is the second most frequent cause of the acute surgical condition of the abdomen in infancy and child-

hood and the most common cause of acute intestinal obstruction in this age group.

2. While the overall mortality has shown a progressive improvement during the past forty years, it is still distressingly high.

3. Intussusception has been found to be irreducible in approximately 12.4 per cent of the published series.

4. The various surgical procedures for the management of irreducible intussusception have been outlined, with the reported mortality figures.

5. Resection with immediate anastomosis is the most practical method of handling the irreducible case and has resulted in a steady drop in mortality rates in recent years.

6. It is suggested that a decision as to necessity of resection be made as promptly as possible after reasonable manipulation has been carried out to limit the operative time and to reduce the lethal factors of postoperative shock and toxemia.

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DUO LIQUID ADHESIVE

ITS USES IN NEUROSURGERY

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IT has always been the practice of neurosurgeons to shave the entire head in preparation for cranial operations. The only exception to this practice found in the literature is suboccipital craniotomy. In some of Dr. Cushing's illustrations the occipital region only was shaved in cerebellar cases and the long hair on the front of the head was left in braids. But he consented to save the patient's hair only in very special cases. Dr. Percival Bailey has said many times, "I would never attempt any operation on the head without a complete preparation. The risk of infection is too great. I do not like hair in the field of operation." These sentiments are quite universal among neurosurgeons.

Every neurosurgeon has had the experience of hearing bitter complaints from their female patients who had been told their heads must be shaved for operation. Women patients have even refused to be operated upon if their heads had to be shaved. They would "rather die (from their brain tumor, of course) than loose their hair." When a woman is that vain, one begins to look around for a method whereby the operation can be done without completely removing the hair.

In 1938 Duo Liquid Adhesive was obtained from the company* who advocated its use in the application of small dressings to wounds of the scalp and face. For this use it was found far superior to adhesive tape and every other adhesive substance which the writer had used to make dressings adhere to the scalp and face. The idea was conceived of using liquid adhesive to seal off the hair for cranial operation when the patients did not wish to have their entire head shaved. The product was used successfully in this manner for three years. The purpose of this communication is to describe the method of its use in surgery and to acquaint neurosurgeons with a valuable product.

Duo Liquid Adhesive can be used to seal off the hair for any operation upon the head or face. It is most useful, however, in (1) suboccipital operations, either midline cerebellar exposures or unilateral incisions for fifth and eighth nerve sections, etc.; (2) frontal flaps, unilateral or bilateral where the concealed incision is made just behind the hairline; (3) ventriculogram and other exploratory trephine operations; (4) prefrontal lobotomies.

METHOD

The scalp is shaved over the area which is to be exposed for surgery. (Fig. 1*a*.) The hair need be removed only about 1 cm. or so beyond the line of the scalp incision. The liquid adhesive is supplied in a tube and has the appearance and consistency of tooth paste. It is applied about the shaved area, half in the hair and half on the bare scalp. (Fig. 1*b*.) Four to six thicknesses of gauze cut large enough to cover the entire head and hair are placed over the head and the soft paste worked through the gauze by gentle pressure with a blunt object. (Fig. 1*c*.) Only two to three minutes are necessary for the adhesive paste to dry and the gauze to become firmly adherent to the scalp and hair. With a sharp scissors the gauze over the operative area is cut off. (Fig. 1*d*.) The exposed area of scalp can now be scrubbed for sterile preparation with soap and water, iodine, alcohol or any other liquid (except ether) without fear of dislodging the dressing.

* Duo Liquid Adhesive was obtained from The Johnson & Johnson Co., New Brunswick, N. J.

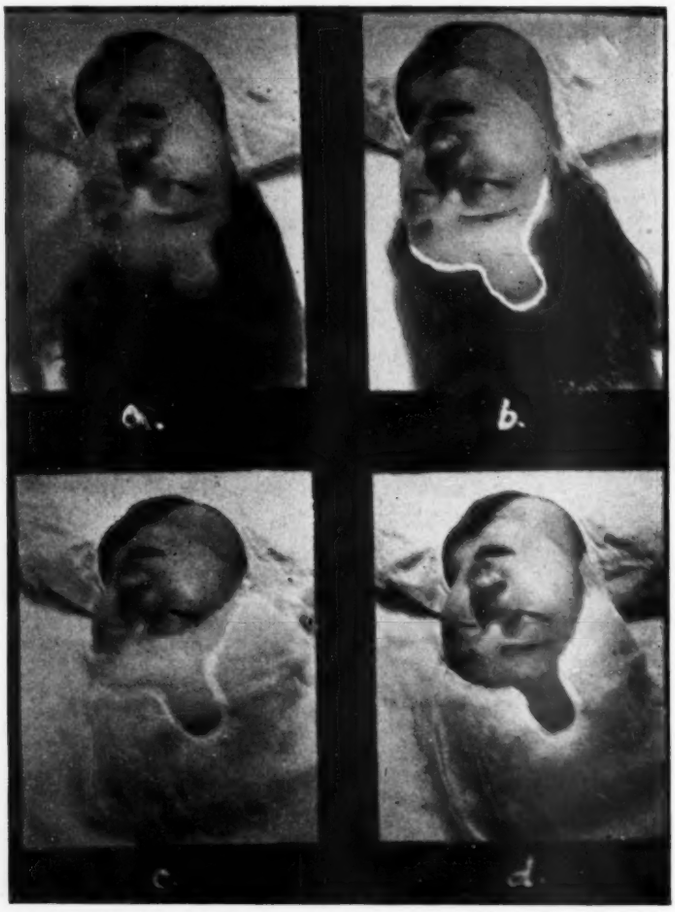

FIG. 1. Method of sealing the hair in preparation for ventriculogram. *a*, small area shaved. *b*, liquid adhesive applied half on the hair and half on the scalp. *c*, head covered with gauze and adhesive paste worked through it. *d*, gauze cut exposing operative field.

The liquid adhesive is a rubberized compound and aqueous or alcoholic solutions do not interfere with its adhesive property. The skin incision is then scratched 1½ cm. (or more) inside the gauze edge, draped with sterile wet towels and secured to the scalp with sutures or small towel clips. The towels are then raised and a thin rubber sheet is slipped between them and the gauze. The patient's head and hair as well as the gauze covering it are thus kept clean, dry and free from blood stains.

At the end of the operation the large gauze dressing covering the hair is not removed but left adherent to the scalp. Sterile dressings are placed over the wound and the entire head bandaged. On the second or third postoperative day, when the skin sutures are removed, the large gauze square may be taken off and the wound covered with a liquid adhesive dressing. The gauze may be left in place until the wound is completely healed. Upon removing the dressing one will find that all of the liquid adhesive adheres to the gauze and comes off with it. None is left on the skin or hair to be cleaned off with ether and benzene as is necessary with other adhesive products.

CONCLUSIONS

1. Duo Liquid Adhesive has been used in cranial surgery to seal off the hair from the operative field and thus obviate the necessity of shaving the entire head.
2. The method of its use is described.

Case Reports

SOLITARY CALCIFIED CYST OF THE SPLEEN*

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CYSTS of the spleen are rarely encountered in surgical practice. According to Gallagher and Mossberger[8] in 1942, 155 cases of non-parasitic cysts of the spleen had been reported. Eight additional cases have been found in available literature since that time.[2,4,9,13,15,16]

There are many classification of cysts of the spleen. The most satisfactory is the classification by McClure and Altemeier[10] which is a modification of those submitted by Moynihan[11] and Fowler.[5] Cysts of the spleen are divided into true and false cysts depending upon the presence or absence of a specific lining membrane. True cysts have three subdivisions: (1) epithelial which may be dermoid or epidermoid; (2) endothelial which include lymphangioma, hemangioma, polycystic disease and some serous cysts; (3) parasitic, lined by a protoplasmic matrix as the echinococcic cysts. The false or pseudocysts have only a hyaline fibrous wall or a condensed rim of splenic tissue. False cysts have four subdivisions: (1) hemorrhagic or (2) serous, depending upon their contents; (3) inflammatory, due to acute necrosis in infections; (4) degenerative, due to liquefaction necrosis in infarcts.

According to Fowler,[6] echinococcic cysts occur about twice as frequently as all the various forms of non-parasitic cysts. The incidence of false cysts is about four times as great as that of true cysts. About 80 per cent of the false cysts are large, solitary and unilocular, about two-thirds being hemorrhagic and the others being serous depending upon the nature of the contents. We wish to report a case of solitary, calcified, serous pseudocyst of the spleen.

CASE REPORT

The patient, a forty-eight year old white, unmarried woman, was sent to the hospital February 3, 1946, by Dr. C. J. Barone. She complained of a feeling of fullness in the left upper part of her abdomen aggravated by eating. At times she had dull aching pain in that area and felt that something was pressing upward into her chest.

In 1928, after running down a steep hill, she bumped into the corner of a building and injured her left anterior chest wall and left iliac crest. She heard "gurgling sounds" in that area and later noted some swelling of the upper abdomen. Three ribs on the left side were fractured. The pain gradually subsided. In 1931 she fell forward in a bus and again injured her left chest and upper abdomen. There were no fractures. Since that time she had intermittent dull pain in the upper left abdomen associated with indigestion, flatulence and attacks of vomiting. In 1943 she fell down a short flight of stairs but there was no apparent injury.

Physical examination revealed an obese, well developed, forty-eight year old white woman not appearing ill. The eyes, ears, nose and throat were normal; the lungs were clear; the heart was not enlarged and there were no murmurs. Abdominal examination revealed a heavy panniculus without scars or herniation. Palpation elicited no tenderness and no organs or masses could be felt. No assymetry was present and there was no bulging in either flank. Blood pressure was 140/90, pulse 78, temperature 98.6°F and respirations 18.

Laboratory data: Urinalysis negative; Kahn negative; the hemoglobin was 80 per cent;

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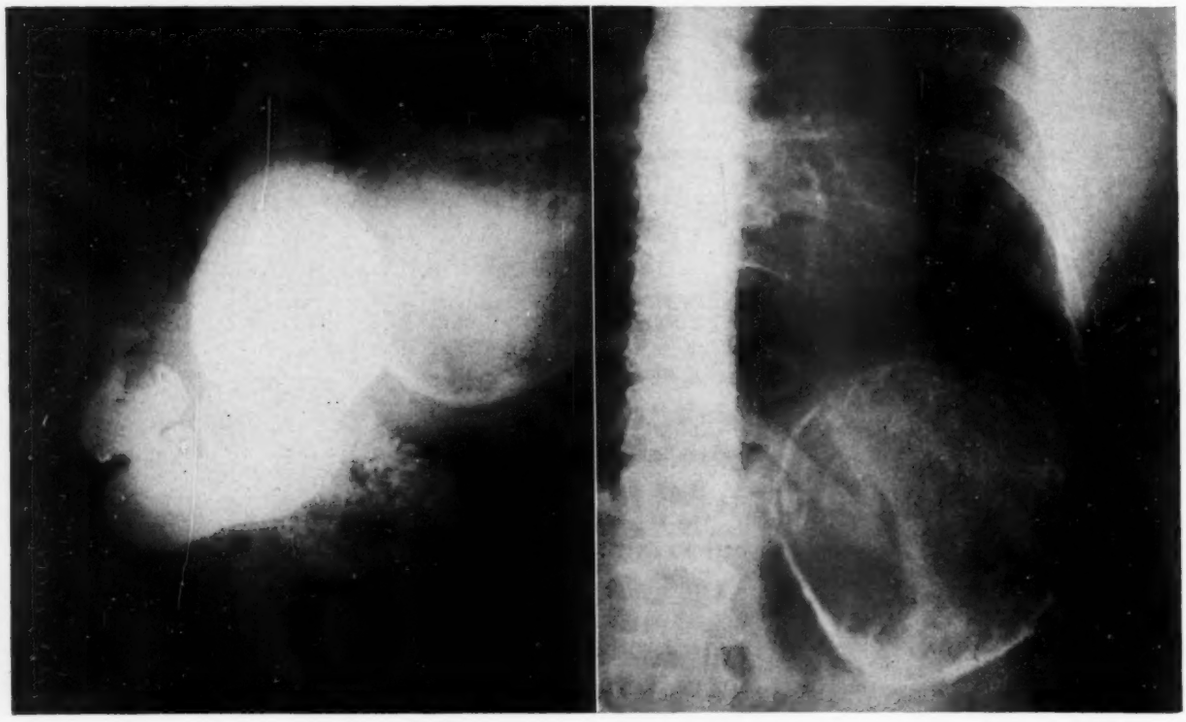

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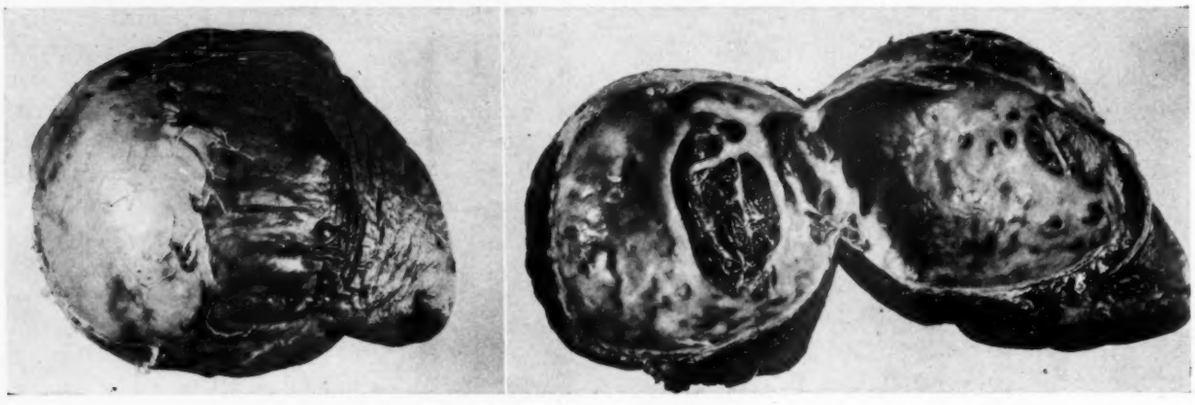
FIG. 1. Film taken after barium meal showing calcified mass beneath the left diaphragm.
FIG. 2. Film showing large partially calcified mass in the left quadrant.



3 4

FIG. 3. Lateral view of the resected spleen showing bulging of the calcified mass.
FIG. 4. View of the cut spleen showing the cyst.

the red blood cell count was 4,010,000; the white blood cell count was 5,600 with 76 per cent neutrophils; the platelet count was 770,000. Coagulation time was four and one-half minutes. Bleeding time was two and one-half minutes. Prothrombin time was 67 per cent of normal. Blood non-protein nitrogen was 30 mg. per 100 cc. of blood. The total protein was 8.0 Gm. with serum albumin 4.9 Gm. and serum globulin 3.1 Gm. X-rays of the abdomen revealed a spherical, partially calcified tumor (possibly within the spleen) in the left upper quadrant just below the diaphragm with a diameter over 4 inches. (Figs. 1 and 2.)

In view of the position of the tumor, history of trauma and the vague, indefinite complaints a tentative diagnosis of splenic cyst was made. On February 8, 1946, under gas ether anesthesia the abdomen was opened through a high, left rectus incision. No free fluid was noted upon opening the peritoneal cavity. There were various adhesions between the diaphragm, stomach and anterior abdominal

wall which were broken by the examining finger. The tumor was found to arise within the spleen and had a dense, calcified wall. The splenic pedicle was quite free and easily clamped and the spleen was removed readily through the wound. (Fig. 3.) The left upper quadrant appeared normal following the splenectomy and there was no bleeding. Examination of the stomach and duodenum revealed no evidence of ulcer. There were some adhesions between the gallbladder and the hepatic flexure of the colon which were readily separated. The pancreas and liver appeared normal. Using interrupted cotton sutures, the abdominal wall was closed in layers without drainage. The patient's immediate postoperative condition was good. One hour later she went into shock. The blood pressure was 80/70 and the pulse imperceptible. She was given supportive treatment and blood transfusions and in a few hours her condition was good. After that she had an uneventful convalescence and was discharged on February 21, 1946.

The pathologic examination was as follows: Grossly, the spleen measured 17 by 10 by 9 cm. At the upper pole, there was a rigid mass which bulged on the diaphragmatic surface of the spleen. In this area the mass was not covered by splenic tissue and was smooth, pale yellow and calcified. The cut section (Fig. 4) revealed a spherical encapsulated cyst filled with thin, reddish-brown fluid glistening with cholesterol crystals. The cyst measured 9 by 8 cm. and its wall varied from 3 to 10 mm. in thickness. The lining was fairly smooth, pale yellow and calcified except for areas of trabeculation between which the rim of splenic tissue was seen.

Microscopically, sections of the spleen revealed the cyst wall to be composed of dense hyalinized connective tissue. (Fig. 5.) There was no epithelial lining and no notable alterations in the pulp, sinusoids or capsule of the spleen.

Diagnosis: Solitary calcified cyst of the spleen.

COMMENT

This case is fairly typical of splenic cysts in general because of the vague, nonspecific complaints of fullness in the upper abdomen and symptoms related to the ingestion of food. The lack of specific complaints has made this condition undiagnosed preoperatively in many reported cases. Other pathologic entities in the left upper quadrant to be considered are tumors of the stomach, pancreas, liver, omentum, kidney and even ovary. Echinococcic cysts which occur twice as frequently as all various types of non-parasitic cysts must be differentiated. This can usually be detected by the complement fixation, precipitin and cutaneous allergic tests.

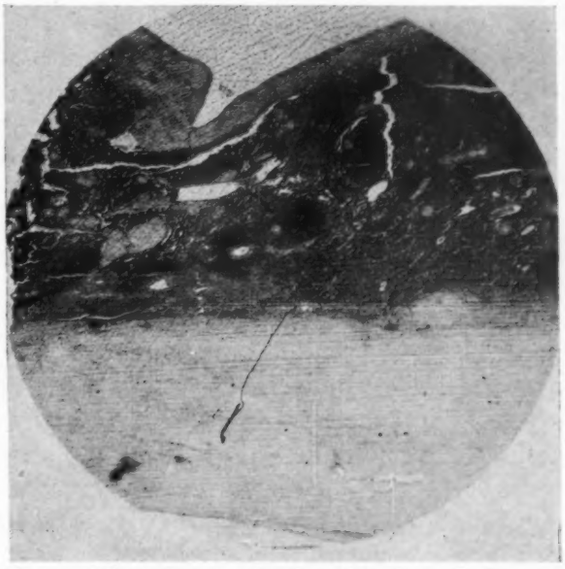


Fig. 5. Microphotograph of section through the cyst showing the wall of fibrous tissue. No epithelial lining.

X-ray is of considerable value in diagnosis either by direct or indirect evidence. In the case presented the calcified wall of the cyst gave direct evidence of a tumor under the left diaphragm although it could not be palpated on careful physical examination. The similarity to a case described by Shawan[14] gave us an excellent clue as to what to expect in this patient. When there is no calcification of the cyst wall, the x-ray evidence is indirect but may be just as conclusive. Ostro and Makover[12] claim that downward displacement of the splenic flexure of the colon is diagnostic of splenic cyst. Interestingly, ordinary splenomegaly does not displace the left colon. As pointed out by several contributors to the subject, displaced viscera always return to their normal location after splenectomy.

Cysts of the spleen are found more often in women. The spleen is congested in pregnancy, menstruation and the menopause. Splenic cysts may be associated with pregnancy.[1] The cases presented by Frank[7] and by Dobrzaniecki[3] tend to show that splenic cysts are affected by menstruation. Frank found it necessary to marsupialize the splenic cyst and for many months there was bleeding from the sinus tract at each menstrual period. The case reported by Dobrzaniecki had severe dysmenorrhea relieved by splenectomy for the splenic cyst.

Trauma appears to be a factor in pseudocysts of the spleen. According to Fowler[5] history of trauma was obtained in 50 per cent of the hemorrhagic and in 16 per cent of the serous cysts. In the case presented the history reveals several episodes of trauma to the upper abdomen any one of which may have produced an intrasplenic hemorrhage without laceration of the capsule. After absorption of the blood a cyst with serous contents and a fibrous calcified wall resulted.

SUMMARY

A case of solitary calcified serous pseudocyst of the spleen is presented.

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SPONTANEOUS RUPTURE OF THE NORMAL SPLEEN

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ACCIDENTS involving the spleen are of frequent occurrence. Among these traumatic rupture is most frequent and is often associated with falls from heights and vehicular injuries. Occasionally such injuries give rise to secondary so-called delayed splenic ruptures in which the initial injury is followed by a latent period varying from a matter of hours to days, weeks or even months. Zabinski and Harkins[1] in 1943 collected 177 cases of delayed splenic rupture from the literature. In the majority of cases the delayed rupture occurred before the end of the first week. Instances have recently been reported[2,3] in which latent periods of four and seven months elapsed between the original injury and delayed rupture of the spleen. An aid to diagnosis in such cases is a painstaking history and a cooperative, intelligent patient.

Less common, but occurring with increasing frequency, is the report of rupture of the diseased spleen. Susman[4] mentions spontaneous rupture occurring in spleens associated with malaria, typhoid fever, pregnancy, leukemia, acute infections, typhus fever, relapsing fever, cystic degeneration, malignant growths, hydatid disease, infarction, torsion, abscess and varices.

Spontaneous rupture of the normal spleen is extremely rare. Brines[5] in 1943 was able to collect from the literature thirty-five authentic instances of spontaneous rupture of the normal spleen. His own case brought the total to thirty-six. If instances to which valid objection might be made in this group were deleted, the total is lowered to twenty-four. Brine's survey is not complete, however, since other cases appeared in the literature prior to his article which he failed to cite.[6,7] The question of whether or not a spleen is normal which ruptures without antecedent trauma or co-existing disease is academic. Again and again reference is made to the contention of Ledderhose and Focault who maintained that spontaneous rupture can occur only in the diseased spleen. Such pathologic conditions which antecede the rupture may be focally localized and the act of rupture is associated with the destruction of the pathologic condition. It must also be borne in mind that spontaneous is perhaps a misnomer since trauma, however minimal, is undoubtedly associated with the rupture. Such trauma might be represented as physiologic and be associated with a sudden increase in intra-abdominal pressure such as that caused by coughing, sneezing, vomiting, lifting, etc.

Clinically, one is confronted with a desperately acute intra-abdominal surgical emergency. Most of these cases are erroneously diagnosed preoperatively as perforated peptic ulcer and less commonly in the female as ruptured ectopic pregnancy. Kehr's sign, that is pain in the left shoulder, is helpful when present and led to the preoperative diagnosis in the second of the two cases herein reported. Zabinski and Harkins[1] found this sign present in nineteen of sixty-eight patients. Because of the tendency to confuse the findings with those found in perforated peptic ulcer, a survey film of the abdomen is usually obtained. It was pointed out in 1944[6] by Levine and Solis-Cohen that in certain instances in such a film the normal splenic shadow is delineated against the outline of the adjacent stomach, especially when the latter is filled with gas. With splenic rupture, blood gravitates along the gastrolienal ligament and the hematoma produces in-

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dentures or serrations along the greater curvature of the stomach. The stomach is also displaced to the right and the colon downward. This observation was recently confirmed by O'Neill and Rousseau.[7] Were such radiologic findings to be constant, the diagnosis would be greatly simplified. In neither of the cases herein reported were such radiologic findings obtained although flat plates of the abdomen were made in both instances.

CASE REPORTS

Case I. A soldier, aged thirty-one, was admitted to the hospital on February 11, 1943, at 1:30 A.M. He was perfectly well until five hours earlier, at which time he began to have severe, sharp epigastric pains which remained fairly well localized. While en route to the hospital, he vomited once, the character of which was unknown to him because of darkness. Upon arriving at the hospital, he had what he described as a normal bowel movement. There was no past history of previous epigastric distress or any history suggestive of peptic ulcer. Careful interrogation both preoperatively and postoperatively revealed no history of recent or late trauma, even of minimal degree. The systemic history was not remarkable.

Examination on admission revealed a white male, obviously in distress due to abdominal pain. The temperature was 100°F., pulse, 90; respiration, 20 and blood pressure, 100/80. General physical examination was not remarkable. Abdominal examination revealed a board-like abdomen with generalized tenderness. Rebound tenderness was present throughout. Liver dullness was not obliterated. There was no radiation of the pain to either shoulder. Peristalsis was active. A survey film of the abdomen showed no evidence of air beneath the diaphragm. Red blood cells were 4,800,000; white blood cells, 18,600; polymorphonuclears, 95 per cent; hemoglobin, 13.4 gr.

Celiotomy was performed through a right upper paramedian muscle splitting incision under spinal anesthesia. Before incising the peritoneum one could observe the dark blood beneath it. About 700 cc. of liquid blood and a quantity of large clots were evacuated from the peritoneal cavity immediately after it had been opened. The spleen was found to be the source of hemorrhage. It was about normal in size and was congenitally fissured with a laceration along the middle fissure. The pedicle was frayed; it was ligated and the spleen removed. During the operative procedure the blood pressure fell to 98/50 and supportive therapy consisting of administration of 1,000 cc. of liquid plasma and 600 cc. of whole blood was instituted. This resulted in a prompt rise in blood pressure. The patient made an uneventful recovery except for atelectasis which developed on the second day. The platelet count gradually rose on the third postoperative day from a base of 241,000 to 1,360,000 on the eleventh postoperative day. From this maximum height it gradually decreased until the time of dismissal on March 11, 1943, at which time the platelet count was 468,000.

Pathologic report revealed the following: The spleen measured 12 by 10 by 4 cm. There was one large fissure that partially bisected the spleen. Two smaller fissures were present at one pole. At the opposite pole there was a hemorrhagic bullous area 5½ by 4 cm. There was an acutely torn area involving most of the large fissure. The capsule was lifted up by an area of hemorrhage in this region. On section the central portions of the spleen were poorly fixed. The tissue was red, firm and the corpuscles were barely visible. In the hemorrhagic areas, blood penetrated irregularly through the parenchyma. Microscopically, in most regions the spleen was normal. The sinusoids were quite empty. The corpuscles were small and sharply outlined. In the grossly hemorrhagic zone there was considerable distortion of the normal structure by hemorrhage; in other places the blood had diffused through the tissues. The process was acute. There was no significant alteration of the normal structure of the spleen to account for the focal rupture without trauma. Diagnosis: Focal rupture of spleen in normal anatomic fissure; subcapsular bullous hemorrhage and focal interstitial hemorrhages.

Case II. A soldier was admitted to the hospital on June 28, 1945, from another installation with a transfer diagnosis of "Observation for renal colic manifested by pain in the left chest and left upper abdomen." The symptoms began two days prior to admission when he was awakened from sleep at about 2:00 A.M. with severe pain in the upper left quadrant of the abdomen and around the heart which radiated to the left shoulder. He had no

nausea or vomiting at the time. The pain continued and he was admitted to a nearby medical facility thirty hours after the onset of symptoms. While there his pain became worse, and he was observed for another twenty-four-hour period before being transferred.

The past history gave no indication of previous digestive disturbance. He stated that his health was excellent prior to the onset of pain. He had had no discomfort to limit his general activity. Careful questioning revealed no history of injury. In November, 1944, approximately seven months prior to the onset of the present illness, he was subjected to a severe concussion by the explosion of a booby trap near him while on duty near Germany. He received no fragment wounds or injuries other than the concussion, and he was returned to full duty in February, 1945. At the time of admission he complained bitterly of pain in the left epigastrium and pain in the left shoulder. The patient appeared to be quite ill and was lying doubled up on his side, loathe to move. General physical examination was unrevealing. There was no marked pallor of the skin or mucous membrane. Abdominal examination showed a tense, rigid abdomen with extreme tenderness in the left upper quadrant and in the region of the midline. Peristalsis was active. There was rebound tenderness throughout the abdomen. Liver dullness was not obliterated. The temperature was 100°F.; pulse, 120; respirations, 22; blood pressure, 104/70; red blood cells, 4,190,000; hemoglobin, 76 per cent; white blood cells, 24,000; polymorphonuclears, 97 per cent. A flat plate of the abdomen failed to reveal the presence of free air in the abdomen.

A probable diagnosis of perforated peptic ulcer was made with a provisional diagnosis of possible spontaneous rupture of the normal spleen. The patient was taken to surgery and an upper midline incision made. Upon opening the peritoneal cavity a large amount of blood was found. On exploration the source was revealed to be the spleen. To facilitate exposure a transverse incision was made to the left from the mid-portion of the midline incision, cutting across the rectus muscle. The spleen seemed to be enlarged about three to four times its normal size, but upon further inspection this apparent increase in size was due to a massive subcapsular hemorrhage. Fresh bleeding was originating near the hilus. It was estimated that about 1,600 cc. of blood represented by free blood and clots were found in the abdomen. The patient's postoperative convalescence was uneventful. The platelet count was carefully followed postoperatively. From a normal of 283,500 it never rose higher than 350,000 over the period of observation for the next two months. Upon release from the hospital the blood count was well within normal limits.

The pathologic report revealed the following: The specimen consisted of a spleen measuring 11½ by 6½ by 4 cm. It weighed 125 Gm. The capsule over the surface of the spleen was stripped almost entirely except for a triangular surface at the lower pole. The capsule over the anterior inferior surface of the spleen was also stripped from the hilus. At the lower pole of the spleen there was a clot measuring 4 by 2.5 cm. between the capsule and the spleen. Microscopically, in one section there was a large extravasation of blood between the splenic pulp and the capsule. The lymph follicles in the spleen were distinct. The sinusoids were relatively empty. There was some hypertrophy of the lymph endothelium and in other areas there was interstitial hemorrhage which completely replaced the normal splenic elements. Diagnosis: Rupture of spleen, presumably at the hilus, with extravasation of large amounts of blood beneath the capsule and secondary rupture of the capsule.

Autotransfusion is an extremely valuable supportive measure in such instances as have been previously described. The sterile apparatus necessary for this procedure may be kept available in all surgical pavilions in anticipation of just such contingencies. One never knows whether or not the next anticipated perforated ulcer might not turn out to be a spontaneous rupture of the normal spleen. The blood is usually desperately needed and although a great deal of the blood may be clotted, sufficient can be collected in liquid form to be of value in preventing profound shock or a fatality. The apparatus consists of the ordinary 1,000 cc. bottle such as is universally used in the parenteral administration of electrolytes. Into this is placed 100 cc. of 5 per cent sodium citrate. A two-hole rubber stopper is used. Through one opening a glass tube is connected by rubber to

any source of suction. A glass tube passing through the other opening is connected to the suction tip. This apparatus can be kept in sterile condition, ready for use at an instant's notice. The liquid blood is sucked into the collecting bottle and after the entire amount is collected, normal saline is added to bring the volume to 1,000 cc. This is then stirred and is strained through six thicknesses of ordinary mesh gauze, using a glass funnel. It is then ready to be administered as an autotransfusion.

SUMMARY AND CONCLUSIONS

Two instances of spontaneous rupture of the normal spleen are reported. A presumptive diagnosis was made in the second case. In both instances a marked preoperative elevation of the polymorphonuclear count in the differential was noted. In neither instances was there clinical evidence of severe hemorrhage in spite of the presence of formidable quantities of blood in the free peritoneal cavity. Kehr's sign was present in the second case. In neither instance was the so-called diagnostic x-ray evidence of dilatation of the stomach and serrations along the greater curvature noted on preoperation survey films of the abdomen.

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CALCIFIED MUCOCELE OF THE APPENDIX

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MUCOCELES of the appendix are rather rare and are very seldom diagnosed preoperatively. A calcified mucocele of the appendix is even more rare and this is the only one that the author has seen so far.

CASE REPORT

Mrs. A. B. C., age seventy-nine, a white, widow, first consulted the writer on October 15, 1943. Her chief complaint was attacks of pain in the right upper quadrant which were very severe. The pain radiated to the right back. These attacks began some twenty years ago, but only in the past few years has she required hypodermics in order to obtain relief. The attacks were usually associated with a good deal of nausea but no vomiting, except rarely. She had a good deal of indigestion, gas on the stomach and belching, but this was mostly during an attack.

Previous clinical history revealed that the patient had the usual childhood diseases and had typhoid fever in 1911. She was in bed three months with this but remembers no definite complications. She has had much trouble with constipation all her life. She has never been jaundiced and has had no operations. She had eight children and two miscarriages; most of the eight children are living and well at present.

Examination revealed the following: temperature 99°F., pulse 84, blood pressure 140/80. The lungs were negative. The heart was not enlarged and the rate was not excessive. No murmurs or arrythmias were noted. The pulse was of good volume, regular and the peripheral arteries were not excessively thick or stiff. The abdomen was somewhat distended. Definite tenderness with slight rigidity was noted over the gallbladder area. A tender, palpable mass was felt in the gallbladder area. Murphy's sign for gallbladder disease was positive. The liver and spleen apparently were not enlarged. In the right lower quadrant there was a very hard, rounded mass which was freely movable within certain limits. It was not definitely associated with the kidney. Its extreme hardness was noteworthy. Thinking perhaps it was an inspissated intracecal mass, she was sent home to take a laxative that night, to be followed with an enema the next morning after which she was to come back for a re-check. The mass was unchanged in any respect following the procedure first mentioned.

The pelvic examination was negative in every way. An x-ray study was done at St. Joseph's Infirmary by Dr. C. P. Harris and was as follows: November 1, 1943: Mrs. Sallie C. Gallbadder and gastrointestinal series:

"*Preliminary Roentgenograms:* No shadows were seen suggestive of opaque urinary calculi. There is a round calcific density in the right lower quadrant which measures about 5 cm. in diameter. (Fig. 1.)

"*Cholecystograms (oral method):* There was no evidence of concentration of the dye in the gallbladder, and gallstones were revealed within the gallbladder.

"*Barium Meal Examination:* The barium meal passed through the oesophagus normally. There was a fairly large diaphragmatic hernia through the oesophageal hiatus of the diaphragm. The stomach and duodenum filled normally and showed no evidence of an organic lesion. There was a diverticulum at about the junction of the duodenum and jejunum, which measured about 2 cm. in size. (Fig. 2.)

"*Six-Hour Examination:* The barium meal was distributed in the lower ileum and proximal portion of the colon. (Fig. 3.)

"*Twenty-four Hour Examination:* The head of the barium meal had reached the rectum. There was a residue in the proximal portion of the colon, and the rounded calcific mass in the region of the cecum appeared to be more opaque than prior to administration of the barium meal. (Fig. 4.)

"*Barium Enema Examination:* The colon filled almost completely and multiple diverticula were present in the sigmoid. The cecum and ascending portion of the colon were markedly dilated and the round mass previously described apparently communicated with the colon. (Figs. 5 and 6.)

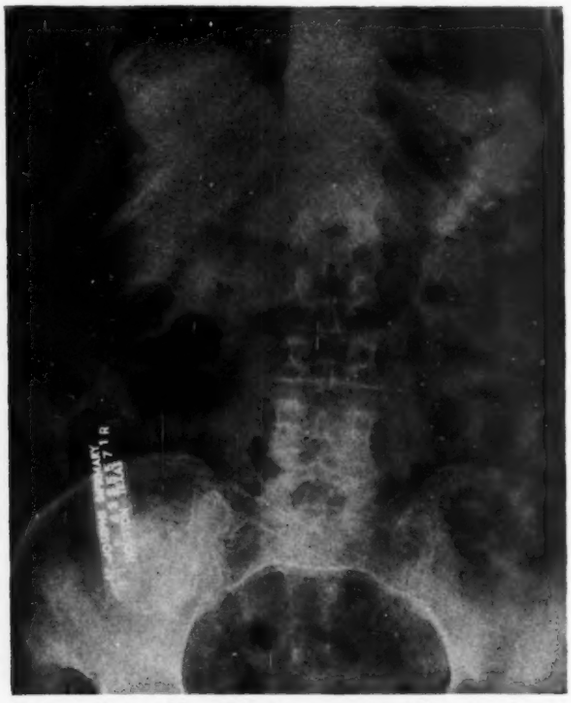
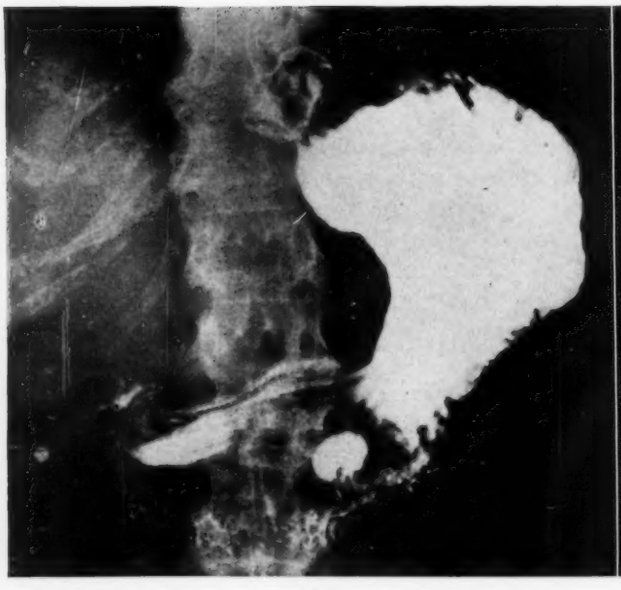


FIG. 1. Scout film showing round calcific density in right lower quadrant.



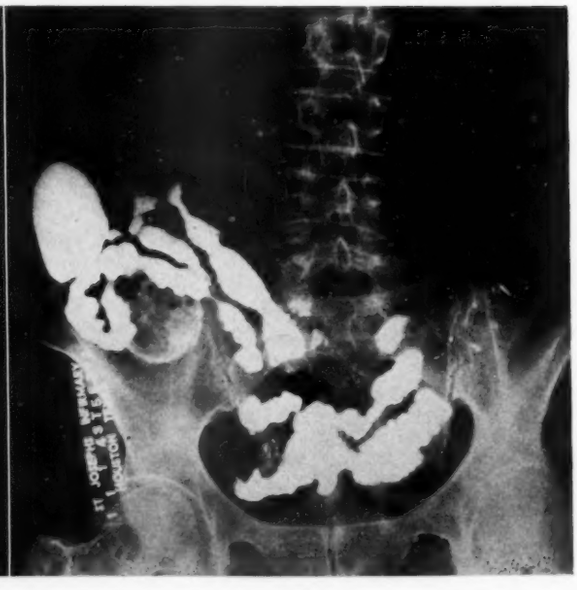


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FIG. 2. Note diaphragmatic hernia and large diverticulum of duodenum near duodenojejunal juncture.
FIG. 3. Barium meal indicates mass near cecum.

"*Conclusions:* (1) Non-functioning gallbladder which contains gallstones. (2) Diaphragmatic hernia through the oesophageal opening of the diaphragm. (3) A diverticulum was present on the ileum at junction of the duodenum and jejunum. This diverticulum emptied normally. (4) The colon showed multiple diverticulae in the sigmoid region, and the cecum and ascending portion of the colon were dilated. There was a round, dense shadow at the lower margin of the cecum which became more opaque after administration of the barium meal. This shadow is not definitely identified. It is possible that it does not communicate with the cecum."

She was advised that the main source of

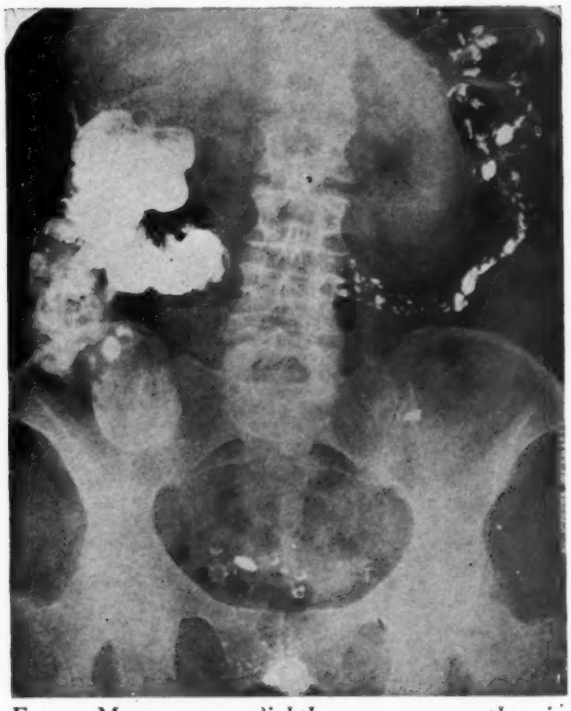
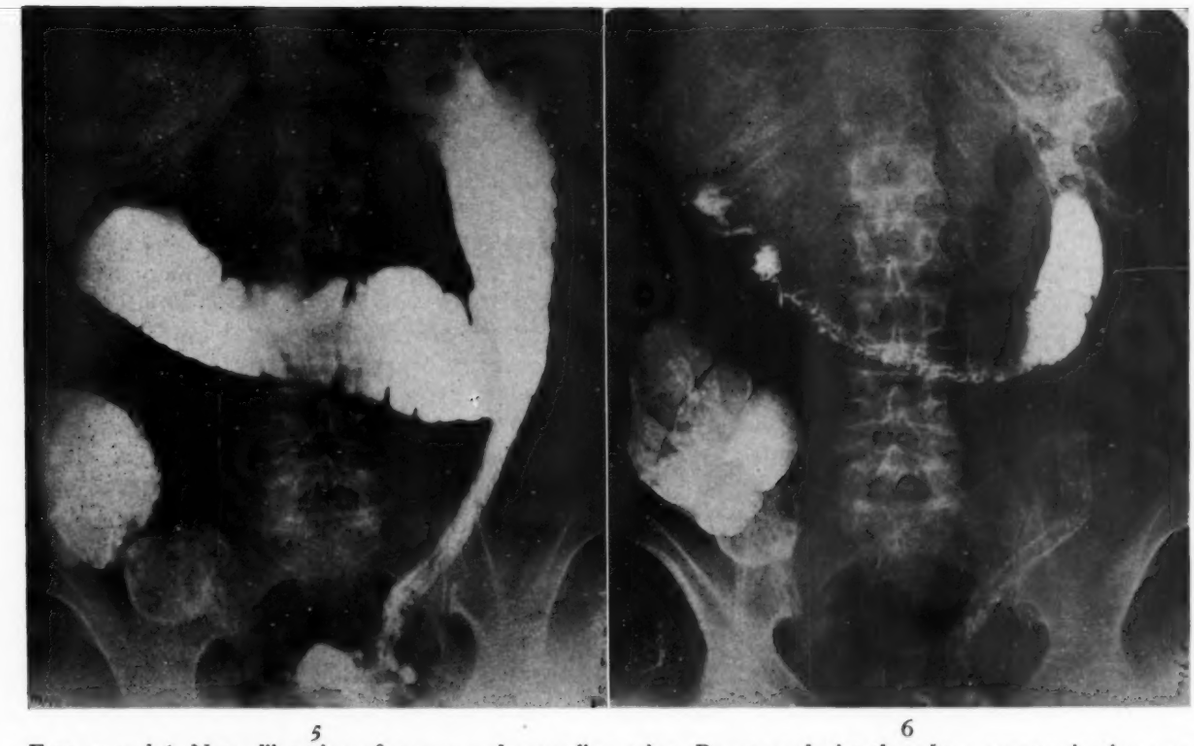


Fig. 4. Mass appears slightly more opaque than in Figure 1.



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Figs. 5 and 6. Note dilatation of cecum and ascending colon. Roentgenologist thought a communication was possibly present between mass and colon.

FIG. 7. The round mass as seen when cut open; the walls had to be cut with a small saw.

trouble was the diseased gallbladder and that it should be removed. She was also advised that no diagnosis of the ileocecal tumor had been made, and that as it did not appear to be troubling her much its removal was not seriously contemplated. The diaphragmatic hernia and the diverticulum of the jejunum also were not considered for surgical treatment, due respect being had for her age and general condition and for the fact that the hernia and diverticulum apparently were giving her little if any trouble.

She entered St. Joseph's Infirmary November 17, 1943. At that time her physical findings were as reported. Her blood showed: hemoglobin, Sahli, 75 per cent; erythrocytes, 4,240,000; leukocytes, 8,700; small lymphocytes, 33 per cent; polymorphonuclears, 65 per cent; basophiles, 2 per cent; urinalysis: Yellow, clear, acid, specific gravity, 1.015; albumin, negative; sugar, negative; casts, none; mucus, one plus. Epithelium, few, pus, occasional; bacteria none.

Operation was done November 18, 1943, using cyclopropane anesthesia. An upper oblique incision was used, cutting the aponeurosis of the external oblique transversely and splitting the internal oblique and transverse in the line of their fibers. The right rectus was cut transversely. The gallbladder was very contracted, adherent and difficult to dissect but was found filled with stones on final removal. Removal was done from within out, carefully ligating the cystic duct and artery.

After this the ileocecal mass was brought up. Even then it was hard to ascertain its origin. It was attached to the cecum exactly where the appendix normally arises. It shelled out fairly easily with little bleeding and was as hard as a rock. There was some mucinous material on its outer surface; this mucinous material had exactly the same general physical appearance and characteristics as the mucinous material found in the more common pseudomucinous cyst of the ovary. None of this material was found elsewhere in the abdomen. The ovaries were entirely atrophied and showed no signs of any disease whatever, there was no cyst, even a small one, in either ovary. No appendix could be found after the removal of this tumor mass, no opening into the cecum or ileum could be determined, as apparently this mass was completely sealed off from the gastrointestinal tract. A free graft of omentum was tacked over the site of removal and, after placing a single Penrose drain in the foramen of Winslow, the abdomen was closed in layers.

The *pathological report* on November 19, 1943, by Dr. A. H. Braden was as follows: "A gallbladder that measures 9 × 4½ cm. It has a thickened wall and contains multiple calculi. the largest of which measures 1 cm. across,

The mucosa shows extensive inflammation and necrosis.

"A mass removed from the region between the cecum and the ileum measures 9 cm. across and 6 cm. in diameter. The wall shows extensive calcification and the cavity is filled with thick, mucinous material. (Fig. 7.)

"*Diagnosis:* Cholecystitis; cholelithiasis; calcified mucocele of the appendix."

The patient made an uneventful recovery, but did develop an auricular fibrillation on the second postoperative day. This was controlled by digitalis.

She went home on the seventh day and got out of bed the same day without ill effects. She celebrated her eightieth birthday two weeks after the operation and has been well ever since.

SUBCUTANEOUS, SUBTOTAL TRAUMATIC AMPUTATION OF A THIGH

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CRUSH injuries and incomplete traumatic amputation of fingers and toes are commonplace; injuries of limbs are not as common but are not rare. Conservative treatment of these injuries often results in the saving of these appendages and limbs. As in finger injuries surgical repair of the limb is highly desirable because what frequently appears to be a hopeless injury turns out to be a striking success.

The problem in traumatic incomplete amputations through the larger portion of the extremities, however, is always difficult and the successes more unusual than those obtained in finger injuries. Conservative operative treatment is less certain because of the larger mass of soft tissues and because a larger blood supply is necessary. It is idiomatic that the volume of blood supply necessary is proportional to the tissue mass to be supplied and hence the blood volume necessary diminishes as the wound moves distally. The one essential which will determine success or failure is an adequate blood supply.

The following case report is interesting because it was almost entirely a subcutaneous injury which was quite extensive; it was a subtotal section of both soft and bony tissues through the thick part of the thigh. As the author had never read of a similar case it was believed worth while reporting.

A brief reference to the literature revealed at least one author, Abdelsamie,[1] who advocated early amputation in severe crush injuries to the extremities and who stated that with delay shock comes quickly and death follows. Few other references were found on crush injuries to the extremities. However in severe injuries and incomplete amputations of the extremities most authors advised conservative treatment.[2,3] Jones advocated conservative surgery if at least one large artery remains.

In this case and in many others due to gun shot and shell fragment wounds in all parts of the extremities, the author's experience coincided with that of Jones. The ultimate function was not always normal but the limb was usually saved if at least one large artery remained.

CASE REPORT

A young negro male, A. G., aged thirty-five, was injured on September 15, 1943 when a car backed up and caught the patient between the back end of the truck and the edge of a work bench crushing his right thigh in the middle third. He was at once taken to the hospital for treatment; his general condition was moderately good, his pulse was 120, respiration 35, temperature 101.8°F. and no appreciable shock was evident. Locally the entire right thigh was markedly ballooned out, swollen and distended. and upon palpation the skin was tense throughout the circumference. There was a dark discoloration of the skin over two areas, about ½ by 2 inches on the anterolateral surface of the thigh but no perforations were found except for a tiny puncture wound posteriorly which was considered superficial.

No indentations were felt in the thigh on the first examination and motor power and sensation in the leg below the knee were normal. He was immobilized in a Thomas splint and traction was applied while roentgenograms were taken. These revealed a transverse fracture of the middle femoral shaft with marked displacement posteriorly of the distal fragment. He was given 1 cc. tetanus toxoid and ½ gr. of morphine and put to bed with a dressing to the posterior wound. About two hours later it was noticed that the posterior wound continued to bleed through the dressing.

His pulse rose to 128, respirations to 40 and temperature ot 102°F. It was then determined to explore the wound keeping in mind the probability of a compound fracture with injury to the hamstring muscle group. At the onset of operation the blood pressure was 114/68 and pulse 112.

It was planned to reduce and immobilize the fracture with the Anderson pin method, utilizing external bars for fixation. Therefore, two pins were placed obliquely in the greater trochanter area and two more in the lower lateral femur. After fixation was complete the patient was turned over and the perforating wound débrided. Upon enlarging the wound to find the bleeder, the exploring finger at once revealed an enormous defect in the muscle bellies of the posterior thigh. The incision was enlarged to 5 inches and complete severence of all musculature except a thin strip covering the bone in which lay the sciatic nerve was found. There was pulping of the muscles over a width of about 2½ to 3 inches from one side of the thigh to the other and much of the crushed muscle could be picked out. Excision of the edges of the crushed muscle was done both distally and proximally, but still the muscle did not bleed readily nor contract upon pinching. A 2 inch wide gap in the muscle had already been made and it was feared that if the gap was made larger it could not be closed. Therefore, it was decided not to excise more muscle but to leave the rest in hope that the damaged ends would become replaced with scar. The sciatic nerve was not exposed as prior to operation there was no evidence of sciatic nerve injury. Apposition of the muscle bellies was made with some difficulty by interrupted chromic No. 1 sutures after 10 Gm. of sulfanilamide powder were left in the wound. Fascia and subcutaneous tissues and skin were likewise closed in layers, but the fascia could not be closed completely and a ¼ inch gap remained. One rubber drain was left in the wound for drainage. Assuming that if the heavier musculature were crushed posteriorly certainly the anterior group also was injured, further deep palpation anteriorly was made which revealed indentation in the continuity of the quadriceps muscle anterolaterally under the bruised skin area. A 6 inch transverse incision was made through the tense skin and fascia, the edges of which pulled apart at once. Masses of pulpy muscle tissue were found and no muscle continuity was found anywhere anterior to the bone. Exploration revealed a very small strip of intact musculature laterally and a small but larger bundle medially enveloping the femoral artery which could be palpated and which felt intact. All the loose masses of pulped muscle were removed and all the muscle ends freely excised until a 2 inch wide gap was present. Although the muscle ends still did not contract and were dull in color, it was decided not to remove more for fear of not being able to close the wound. We chose to let subsequent scar replacement maintain continuity rather than to have a perfectly débrided but useless muscle. The bone ends were reduced and a six hole bone plate was applied, the end of the distal fragment being forcibly tapped to cause impaction at the fracture line before tightening down the screws. One test screw which was first placed at one end of the plate and incompletely tightened was forgotten so that only five screws held the plate firmly, three above and two below the fracture line. Closure of the muscle wound was made with loosely tied interrupted chromic sutures. The fascia was extremely tense and complete closure was found to be impossible, a ¼ inch gap remaining. The skin was closed with interrupted silk except for a small area which had been bruised anterolaterally and which was not excised because of the already tense skin. Closure of the skin was already difficult and further excision of the skin was decided against as it was uncertain how much of the bruised skin was devitalized. Eight Gm. of mixed sulfa powder were left in the wound but, as occurred in the posterior wound, much of it was lost with draining blood at the site of the rubber drain. The external bar supports were tightened down and the patient was put to bed.

Whole blood in 500 cc. amounts were given to the patient on September 16th, 19th and 23rd, and the blood count rose from 2,770,000 on September 16, 1943, to 3,320,000 on September 26, 1943, and subsequently it gradually rose to normal. The Wassermann test was negative as were the urinalyses. There was never any indication of anuria which occurs in some crush injuries. Gas antitoxin 3 cc. was given intramuscularly on September 16, 1943, and sulfadiazine was begun with 2 Gm. and thereafter 1 Gm. every four hours. His blood level rose to 9.1 mg. per cent on September 17, 1943, and it fluctuated there-

after until October 17, 1943, when the sulfadiazine was stopped.

The patient's general condition was never bad and his temperature never rose higher than 102°F. It was most interesting to observe the progress of the injured thigh. For thirty to thirty-two days the thigh remained swollen, edematous and tense. From the first there was some serous drainage from both wounds which was accompanied on September 21st by a bulging of the medial thigh. This was aspirated but no fluid was found. On September 22nd both anterior and posterior wounds were explored but no pockets were found. On October 1, 1943, several pockets were opened up and were found to be filled with necrotic tissue. The necrotic tissue was excised, the pockets dusted with sulfanilamide powder and a vaseline gauze drain was left in. The skin, which after injury appeared severely bruised on the anterolateral thigh, became necrotic and was on this date excised.

The drainage gradually decreased and was at no time purulent, being more of a serous type. During some of the dressings small amounts of necrotic tissue were removed but there was never any massive necrosis. Where the necrotic tissue had been excised granulating areas resulted, one was about 1½ by 1½ inches and the other about 1 by 1 inch. On November 1, 1943, pinch grafts were applied to the granulating areas. Another narrow granulating area on the posterior medial aspect of the thigh was excised and a closure of the wound was made. Healing was uneventful. Roentgenograms of the femur taken October 14, 1943, showed good position and a small amount of callus at the lateral margin of the fracture line.

On December 12, 1943, the pins were all removed and external fixation was discontinued. Clinical union was solid and a Thomas splint with a Pierson attachment was applied for further protection and to permit motion of the knee. Some active contraction of the vasti could be seen and felt. On this date the knee moved from 180 to 135 degrees. Roentgenograms taken January 15, 1944, revealed some slight angulation of the bone plate and incomplete union; there was little callus on the plate side of the femur where it appeared that the plate was holding the fragments apart. The plate was removed January 17, 1944, and because of insufficient callus on only the medial side, a sliding graft was made and external support provided with a double hip spica cast. On March 17, 1944, the cast was removed and both clinical and x-ray union were found present. Exercise and physiotherapy was again begun and walking with crutches was permitted on April 8, 1944, when there was active motion in the knee from 180 to 135 degrees. A caliper splint was applied for protection and gradual improvement was noticed with use, exercises and physiotherapy. Strong active contractions of all thigh muscles were present and in the quadriceps and hamstring muscles there was continuity of the proximal and distal muscle bellies. Thus the fibrous bridge joining the two was a functioning one. The muscle bellies both above and below the area of injury appeared to contract actively and the strength was about 75 per cent normal. By May 27, 1944, the patient walked without support but the knee was still limited, motion being 180 to 135 degrees. Further improvement was anticipated but the patient was returned to the mainland and hence the final result is unknown. An attempt to reach him by correspondence failed.

COMMENTS

One point of interest in this case was the decision to avoid complete débridement. Usually complete débridement is necessary for the best results but such procedure here was feared. Much divergence of opinion might be found regarding the decision to leave damaged tissue in a wound but the good result in this case would appear to justify the method employed. In favor of the conservative method used was the avoidance of resecting some good muscle tissue with the devitalized and of the subsequent necessity to make strong traction with sutures on the muscles for apposition which would diminish still further the already damaged blood supply. To do a thorough débridement would assuredly result in a clean granulating wound but one which might be impossible to close at a later date, remembering that such an extensive gap would have been circumferential except for a slip of muscle medially and laterally. There was a definite risk of massive necrosis. However, such a result

was not feared as the future possible necessity to excise this tissue would probably result in a wound no worse than that deliberately obtained by complete primary resection. Since gross contamination did not occur and because early treatment of the patient was possible, infection was not anticipated. The use of sulfa drugs probably helped to prevent this.

An intact skin with its intact blood supply in addition to the femoral artery was no doubt an important factor in the saving of this limb. What little muscle remained also helped in this respect.

Also interesting was the fate of the muscle bellies distal to the wound as much of its innervation must be assumed to have been sectioned. Yet after healing there was felt what was believed to be muscle contraction both anteriorly and posteriorly. The innervation of the quadriceps, the hamstring muscles and adductors occurs chiefly in the proximal muscle bellies of these muscles, but some nerve branches to the quadriceps also pass down laterally[4] which may have been spared from injury just as were the femoral artery and sciatic nerve. As the thigh muscles become tendinous in their distal portions their function would be only partly impaired by section of the nerve supply to the lower portions. Clinically, the thigh muscles functioned fairly well in the act of walking in spite of the partial loss of their innervation and the muscle damage.

SUMMARY

A case report was given of a severe crushing injury to the thigh which was almost entirely subcutaneous and hence was called a subcutaneous subtotal, traumatic amputation. The treatment was conservative and successful.

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FAILURE OF ROTATION OF MID-GUT LOOP*

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THIS case is reported because it is of great interest to note that this boy, although fourteen years of age, had not experienced previously any digestive difficulties not only in his childhood but in his infancy as well. In most cases of failure of rotation or partial failure of rotation of the mid-gut loop symptoms are evident in the first few days of life. In one series[1] 65 per cent of the patients developed symptoms within the first two days of life and 85 per cent within the first two weeks.

In order to better appreciate the errors of development of the intestinal tract one should familiarize himself with its normal embryologic development. The contributions to the literature of Dott,[2] Frazer and Robbins,[3] Gardner and Hart[4] and Haymond and Dragstedt[5] are excellent.

CASE REPORT

D. B., a fourteen year old boy, was admitted to the Norwegian Hospital on December 21, 1945, complaining of severe abdominal pain accompanied by nausea. One week prior to admission the patient complained of abdominal pain which was not as severe as that on the date of admission and which was not accompanied by either nausea, vomiting or diarrhea. The patient recovered from the first attack uneventfully in about one day. On the day of admission, while quarreling with his brother shortly after the noontime meal, the patient received a blow in the mid-abdomen which he dismissed without further consideration. Several hours later the patient was seized with sudden, severe abdominal pain which was most severe in the epigastrium. The patient was nauseated and upon admission began to vomit undigested food particles quite forcefully but not to the extent of projectile vomiting.

The family history was irrelevant. The past personal history revealed a normal full term spontaneous delivery. He was breast fed for a little over six months. Usual dietary and vitamin support were adequate. He had no digestive difficulties and progressively gained weight as an infant. He had measles and chicken pox at the age of two; he also had at the age of eight a sporadic case of poliomyelitis involving the left lower extremity from which he had an uneventful recovery without any after effects.

Physical examination revealed a fourteen year old, well developed and well nourished white male who although rational was uncooperative and writhing with pain. The throat, heart and lungs were normal. The abdomen was flat but was held rigidly, the right rectus muscle being definitely in severe spasm. No masses were palpable. Tenderness was elicited in both lower quadrants and along the right lateral aspect of the abdomen. The tenderness was extreme over McBurney's area and rebound tenderness was also very marked over the same area. Rectal examination proved negative.

On admission the temperature was 100°F., pulse 84, and respirations were 20. Blood pressure was 112/74. Examination of the blood revealed a red cell count of 5,000,000 with a hemoglobin of 106 per cent (Sahli); the white cell count was 15,000 with 82 per cent polymorphonuclears and 18 per cent lymphocytes. Examination of the urine was negative.

With the aforementioned findings, a diagnosis of acute appendicitis was made and under general anesthesia a right McBurney incision was made which revealed a bluish peritoneum. Serosanquineous fluid was encountered in the cavity with the small intestine appearing deeply cyanotic and hemorrhagic. The McBurney incision was enlarged by the method of Weir. Exploration of the abdomen revealed the small intestine to be encapsulated in a mass the size of a football in the upper abdomen. The small intestines were delivered from the peritoneal cavity starting from the ileocecal junction to the ligament of Treitz and the

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mass was reduced. The entire length of the small intestine was hemorrhagic and deeply cyanotic. The mesentery of the small intestine was also very hemorrhagic with the vessels markedly engorged. Following application of hot laparotomy pads to the small intestine and its mesentery, the color was observed to improve considerably. Further work or exploration at this time was considered not advisable because of the patient's extremely poor condition. The small bowel was reposited and the color remained improved. A cigarette drain was inserted, the abdomen was hurriedly closed and the patient was returned to a shock bed. Despite administration of 500 cc. of plasma during the operative procedure the patient was still in shock upon being returned to bed, at which time the blood pressure could not be elicited.

Under treatment the patient slowly rallied to consciousness and his general condition became improved. Vomitus and Wangensteen returns were coffee-ground in nature. The patient became distended and Harris drip irrigations were instituted with serosanquineous fluid being returned. The patient's hydration was closely watched and adequately maintained by means of the fluid balance chart. Protein, electrolyte and vitamin wants were likewise adequately maintained.

The patient's general condition continued to improve and on the tenth postoperative day he was allowed out of bed in a chair. An hour or so after being up out of bed the patient complained of severe epigastric pain. The abdomen was soft and flat. Later in the evening the patient vomited 800 cc. of undigested food. The temperature was 100.4°F., pulse 92 and respirations 22. Morphine sulfate gr. $\frac{1}{6}$ was given for the pain. The vomiting as well as the pain was relieved until the following morning when the pain returned again. The abdomen was still soft and flat and remained so all day. The following morning slight distention in the epigastric area made itself evident. A flat x-ray plate of the abdomen in the upright position revealed dilatation of the upper part of the small intestine and evidence of the presence of a fluid level. From the past history and the evidence on hand the presence of an internal hernia with partial intestinal obstruct on was suspected.

An emergency operation was performed under continuous fractional spinal anesthesia and the opinion of internal hernia with intestinal obstruction was substantiated for upon opening the abdomen by means of a paramedian incision, a globular sacculated mass was found occupying the right upper quadrant. The sac was opened and its contents, comprising about 8 feet of distended small bowel, were delivered from the abdominal cavity whereupon the remainder of the abdominal organs were more plainly visualized. The cecum was anomolously situated, being found in the epigastric region overlying the bodies of the dorsal vertebrae. The ascending and transverse colons were situated along the left border of the dorsal vertebrae from above downward, toward the pelvis and then extended upward to join the descending colon at the splenic flexure. The descending and sigmoid colon were normally situated. At the end of the cecum was found an extremely long appendix, about 16 to 18 cm., retrocecal and bound down by firm adhesive bands from the lateral abdominal wall and also from the area where the ligament of Treitz is normally attached. These adhesions formed the neck or constricting band of the hernial sac. The appendix was removed and the adhesive bands were severed. The duodenal loop was then attached to the severed lateral band for support. The picture was clearly one of failure of the bowel to rotate completely, with arrest of the rotation at an early fetal stage.

The second postoperative course was uneventful until the fifth postoperative day when the patient began to complain of headache and pain upon movement of his neck. The temperature rose to 104.6°F., pulse to 130 and respirations to 35. Physical examination revealed an alert, pale, undernourished male with marked nuchal rigidity and pain on flexion of the head. Positive Brudzinski signs were elicited. The pharynx was slightly injected; the heart and lungs were negative; the abdomen was soft and flat and the operative wound was healing by primary union. On the following day the patient had a convulsive seizure and was transferred to the medical service for treatment.

Examination of the blood revealed a red blood cell count of 3,290,000 with a 66 per cent hemoglobin, a white blood cell count of 9,450 with 65 per cent polymorphonuclears, 32 per cent lymphocytes, 2 per cent eosinophiles and 1 per cent monocytes. Examination of the spinal fluid revealed a cloudy fluid with a large increase in cells, 95 per cent of which were poly-

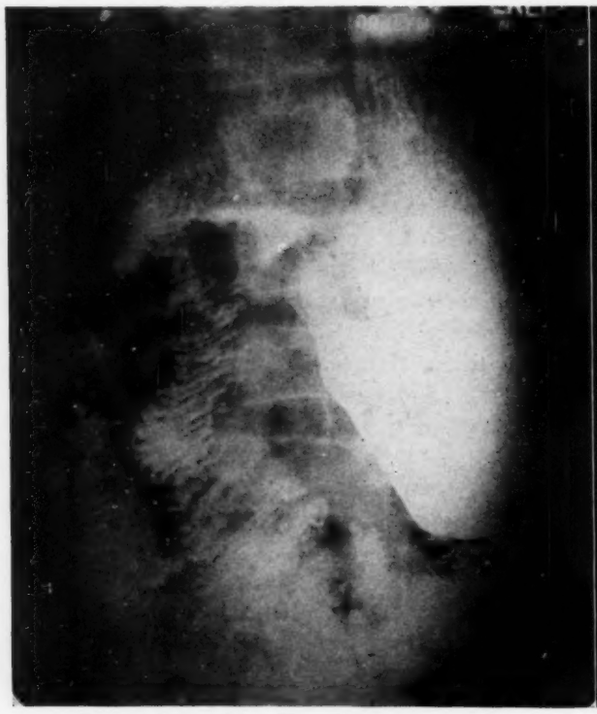

FIG. 1. Immediate film after opaque meal.

FIG. 2. Five-hour film after opaque meal.

morphonuclears. No organisms were seen on smear or in the culture. The sugar was normal while the globulin was slightly increased. The patient was placed on penicillin-sulfadiazine meningitis therapy but the penicillin was soon discontinued on the third day as the clinical picture was that of an influenzal type of meningitis.

The patient recovered rapidly and was discharged on the nineteenth postoperative day (dated from the second operation) after undergoing a gastrointestinal series and a barium enema. He has enjoyed perfect health for the past six months with regular bowel movements each day and no disgestive disturbances.

COMMENT

The gastrointestinal series taken just prior to discharge revealed a normal stomach with no obstruction at the pylorus or in the duodenum. The immediate film after the opaque meal (Fig. 1) reveals the barium passing through the pylorus and filling the duodenum and part of the jejunum. The five-hour film (Fig. 2) shows evidence of hypermotility with the meal having passed into the small bowel and through to the large bowel. Nearly all the proximal half of the large bowel is filled with barium. In this film it will be noted that the entire small bowel lies to the right of the vertebral column. The cecum can be seen overlying the lumbar vertebrae in the midline. It proceeds to the left and downward and what would be the ascending colon is seen to be to the left of the vertebral column and proceeds downward into the pelvis. What would be the transverse colon proceeds upward lying lateral to the loop just described and terminates at the normal splenic flexure. The twenty-four-hour film (Fig. 3) shows the barium to have passed through the previously described large bowel; the descending colon is seen in normal position and some redundancy of the sigmoid is evident.

One of the barium enema films (Fig. 4) shows an excellent picture of the entire large bowel. The dense shadow reveals the redundancy of the sigmoid in the midline. The lesser dense shadow is then seen to extend upward along the lateral abdominal wall to the splenic area. This represents the descending colon in its normal position. From the splenic flexure the shadow is seen

FIG. 3. Twenty-four-hour film after opaque meal.

FIG. 4. Barium enema film.

to descend downward back into the pelvis, this loop represents the transverse colon in its abnormal position. The ascending colon and cecum are then represented by the more medial shadow which extends upward and terminates at the midline overlying the lumbar vertebrae. The pattern of the large bowel as seen in this film is almost identical with that of Sturgeon's case.[7]

This boy, as is clearly demonstrated, is a true case of failure of rotation associated with the usual abnormal peritoneal bands. It is worthy of note that as previously pointed out he had no digestive symptoms prior to admission to the hospital. He exhibited the usual signs of intestinal obstruction and at operation it was evident that volvulus with marked interference of the circulation was present as a result of the abnormal peritoneal bands constricting the enveloped loops of small intestines.

A review of the literature with a tabulation of 103 reported cases was given by Gardner and Hart[4] in 1934 and since then many others have been added. The majority of cases involve malrotation or partial failure of rotation in the second stage. The usual result is a narrowing of the duodenocolic isthmus. This failure of the broadening of the base of the root of the mesentery favors the occurrence of volvulus and intestinal obstruction. The volvulus is not thought to exist prior to birth but is believed to occur shortly after birth when the motor activity of the intestines sets in. This being the most common type of disturbance of rotation it is easy to understand why the majority of cases occur very early in life.

The diagnosis is sometimes very difficult to make but should be suspected when the vomiting comes on in the first few days of life in contradistinction to pyloric stenosis in which the onset is usually after a week. Another distinguishing feature is that pyloric stenosis cases rarely exhibit bile in the vomitus, a fact which definitely establishes the site of obstruction beyond the ampulla of Vater. The vomiting is rarely projectile in character unless there is marked pyloric spasm coexistent. Differentiation from intrinsic duodenal atresia causing obstruction may be made by x-ray

study. If the opaque meal or barium enema reveals a large bowel entirely on the left side, then malrotation with adhesions about the duodenum would be diagnosed; otherwise, with a normal bowel pattern, the obstruction would be considered intrinsic in character.

There is a smaller group of patients in whom the onset of symptoms occur later in infancy or childhood or even in adult life. They may be divided into two groups: The first group comprising those patients in whom the history is one of intermittent attacks with interval periods of greater or lesser duration in which they are free of any symptoms. This group comprises those older cases of volvulus that spontaneously subside and as a rule are not associated with the presence of abnormal peritoneal bands. Spontaneous recovery is usually due to the decompression being accomplished by the violent attacks of vomiting. These children or adults are usually told they have "sensitive" stomachs or "nervous" indigestion until some day, either by x-ray study or at operation, in one of the attacks the true nature of their condition is ascertained. The second group of older patients comprises those cases that are associated with the presence of abnormal peritoneal bands and in whom there is a history of more or less constant discomfort and inability to digest a regular meal. These patients are usually treated for chronic gastritis, gastric ulcers, chronic appendicitis, chronic cholecystitis and gastrointestinal allergy until some day an accurate diagnosis is made by x-ray or at operation. This group of patients is prone to limit their food intake and as a result malnutrition sets in. The patient in the case herein reported had dense bands and belongs to this second group although clinically his symptoms were not unlike those of the patients in the first group, in the sense that one previous attack was reported but this only one week prior to admission to the hospital. In other words our case was unique in that no symptoms at all occurred for a period of fourteen years.

The abnormal peritoneal bands as pointed out by Frazer and Robbins[3] many years ago are the result of the malrotation or failure of rotation and not their cause as still thought by many men. They showed that that there are certain constant and well established areas of thickening in the parieties of the peritoneal cavity which are the normal results of intestinal rotation in the third stage. When abnormal bands are found at operation, most surely if searched for, evidence of some malrotation will be found. Likewise if evidence of malrotation is discovered first, a search for abnormal bands, especially in the area about the duodenum, may prove very helpful for their subsequent release will prevent a future cause for intestinal obstruction. This we were unable to accomplish in our case due to the extreme condition of the patient, but if we could have made the search, the second attack and operation could have been avoided. The first cases of Haymond and Dragstedt[5] and of Gardner and Hart[4] belong in these two groups.

Cases of third-stage failures of rotation are not as common as second-stage failures but many have been reported. Grant[8] reported a case of a seventy-six year old man with a cecum and ascending colon that had a completely free mesentery and was freely movable and also a woman fifty-seven years old with a freely movable cecum having a complete mesentery. The woman also had a series of adherent U shaped loops of duodenum and jejunum. She had complained of epigastric fullness and pain for years. McIntosh and Donovan,[1] case No. 16, was a girl nine years of age who had had attacks of nausea and vomiting every twelve to sixteen months lasting two to five days. Her cecum was freely movable and at operation was sutured to the right lateral parieties.

Cases of reversed rotation in which the distal end of the mid-gut loop enters the abdomen first instead of the proximal end are very rare, only seventeen cases having been reported. Dott[2] reported a case in a sixty-eight year old man and McIntosh

and Donovan[1] reported a case (No. 19) in a thirteen year old boy. In these cases the rotation is 90 per cent clockwise instead of 270 per cent counterclockwise and the superior mesenteric artery and the second portion of the duodenum lies in front of the transverse colon instead of behind it.

SUMMARY

The case report of a fourteen year old boy with failure of rotation of the mid-gut loop associated with abnormal peritoneal bands causing volvulus and intestinal obstruction is presented.

A brief resumé of the clinical status of the problem of intestinal rotation is given with a review of the literature.

The early diagnosis of these cases can be made easily only if the occurrence of the condition is kept in mind. Early diagnosis together with our present day knowledge of the physiologic requirements, both preoperatively and postoperatively, will render our surgical corrections to be more successful than those of our predecessors.

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MESENTERIC THROMBOSIS*

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THE first case of mesenteric thrombosis to be recorded in the literature was in the year 1843 and was reported by Tiedemann. However, it was not until 1895, or fifty-two years later, that the first case of mesenteric thrombosis was successfully resected by Elliott. That the condition is a surgical catastrophe is well exemplified by the fact that until the present time only 116 successfully resected cases have been reported in the literature. Of these 116 patients only twenty-six had more than 200 cm of bowel involved. That the treatment and diagnosis of the condition has improved is illustrated by the fact that in 1921, Klein reviewed the literature and found that there were only twenty-four cases of successful resection reported. Since that date, or in the last twenty-five years, an additional ninety-four cases have been reported.

The etiology of the disease is varied. It may be a result of arteriosclerosis, cardiac disease, liver disease, splenic anemia, polycythemia, or antecedent surgery. The causative factor of thrombosis may be either embolic or thrombotic. The embolic factor is believed to be more frequent and it usually has a cardiac or acute valvular lesion as the producing factor. The thrombotic factor is less frequent and is usually secondary to embolsim. Primary thrombosis is rare. The occlusion may be either arterial or venous. The arterial type may be either general or segmental and may be due either to emboli or thrombi. The venous type, however, is always thrombotic. The manner in which the disease occurs is of far greater importance than is the location of the condition. In the embolic type, which most commonly occurs in patients with cardiac or valvular disease, the embolus arises in the left side of the heart from vegetations on the valves or from a thrombus in the auricle. When the embolus lodges in one of the larger branches of the superior mesenteric artery, infarction results. The superior mesenteric artery is more frequently involved, particularly in embolism, because of its earlier exit from the aorta and also because it is a more direct continuation of the aorta than is the inferior mesenteric artery.

Venous thrombosis of the vessels is usually associated with infection in organs or viscera which drain into the portal circulation and is preceded by appendicitis, inflammatory pelvic disease or ulcerating colonic carcinoma. One should remember in secondary thrombosis when there are no inflammatory lesions in evidence that injury to the vessel walls may be a factor.

The condition which results from vascular occlusion is infarction and is of the hemorrhagic and not the ischemic type. Usually the lower part of the jejunum and ileum is involved. Grossly, the wall of the intestine is thickened and edematous and rapidly becomes purplish-black in color and gangrenous. The bowel wall loses its luster and its elasticity. The lumen of the bowel contains thick, semicoagulated blood which seeps through to the peritoneal cavity producing the bloody ascites which is always associated with the condition. Peritonitis is most common in this condition but perforation is relatively rare.

Microscopically, the lumen of the bowel is filled with a large amount of hemorrhagic fluid. The mucosal lining of the bowel wall shows all stages of degeneration from edema to a condition of true necrosis.

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Edema is seen to be marked in the submucosa. The blood vessels are dilated and filled with large quantities of erythrocytes. The muscular layer and serosal layer show a hemorrhagic reaction.

The condition of mesenteric thrombosis is rarely diagnosed preoperatively. It is most commonly mistaken preoperatively for intestinal obstruction, acute pancreatitis, perforated peptic ulcer or acute cholecystitis. The condition ordinarily has a sudden onset with severe central abdominal pain. This pain becomes colicky in about 50 per cent of the patients. Vomiting is marked from the onset and shock is usually present which varies with the degree of occlusion. Vomiting is overshadowed markedly by the severe pain which helps to differentiate the condition from intestinal obstruction in which the reverse is true.

This sign of pain is the first and the most constant sign of the condition. It is first intense and later becomes intermittent and colicky. Later, when the peritonitis develops, it becomes continuous. The abdominal signs are tenderness, rigidity and distention. Distention is present in about 70 per cent of the patients and one can also find ascites in about 80 per cent of the patients. There is almost always a diminishment in the auditory peristalsis. The temperature is usually subnormal and a rise in temperature is usually a late manifestation. This rise in temperature is preceded by a rise in the pulse rate. Hematemesis occurs in about 20 per cent of the patients and either diarrhea or constipation may be present although constipation is a more frequent finding than is diarrhea. Other signs which may be found are melena, tumor, restlessness, thirst or faintness. The white count may vary between 25,000 and 40,000 but the average white count is about 27,000.

Diagnosis may be assisted by a history of previous surgery, any evidence of other vascular condition and a diagnostic enema which may show intestinal hemorrhage and the findings just listed. When the abdomen is opened, there is an escape of blood-stained fluid and in most cases there is a curious and characteristic smell of putrefaction.

Prognosis of the condition is, of course, very grave. However, the most hopeful thing about mesenteric thrombosis is the fact that it can be cured by surgery. It is well recognized that the mortality rate without surgery is 100 per cent although with the use of heparin, antispasmodics and penicillin this figure may have to be revised. Early diagnosis and immediate surgery offers these patients their only chance for survival. There is a high mortality rate following surgery but, nevertheless, the lowest figures for mortality are reported following surgery. The mortality rate is about 62.5 per cent. It is believed that resection is possible in 80 per cent of the patients operated upon within twelve hours, whereas only 15 per cent can undergo resection after that lapse of time. Prognosis is influenced by the length of bowel involved and on whether or not the bowel can be resected and the extension of the infarct stopped.

The treatment, as previously stated, is immediate surgery. It is important to excise well beyond the limits of the involved segment of bowel and to resect the mesentery down to its root. There is no place for conservatism in treatment of this condition. Excision of the bowel and mesentery is advised even in the most desperate cases in view of the fact that the mortality rate is 100 per cent without resection and is also 100 per cent with exteriorization of the bowel. It is possible to resect 30 per cent of the small intestine and still expect the intestinal tract to return to normal. The average length of the small intestinal tract is 20.5 feet although it varies from 10 to 28 feet. The treatment, therefore, is radical resection of the bowel and mesentery extending into uninvolved tissue, with anastamosis. Postoperatively, papaverine, heparin and penicillin may be used.

The following are two cases with successful resection achieved. Two extremes are

herein presented. The one case is a young female, twenty-seven years of age, with 99 cm. of terminal ileum involved, and the other is a sixty-one year old male with 366 cm. of proximal jejunum and ileum involved:

CASE REPORTS

Case 1. Mrs. V. R., aged twenty-seven, was admitted to the hospital, June 13, 1941. The chief complain was pain in the left upper quadrant and vomiting.

Past history disclosed that the patient was operated upon on June 2, 1941, at which time a Baldy-Webster type of suspension for retroversion of the uterus was performed. A simple appendectomy was performed at the same time. The patient's postoperative course was simple and uneventful. The highest postoperative temperature was 100.4°F. and the temperature on the sixth day was normal and stayed normal. She was discharged on the tenth day with no complaints. She stated that she slept well that night but on arising the next morning she complained of pain in the left upper quadrant. As the morning progressed the pain increased in severity and she vomited twice. She stated that she had a small bowel movement but that there was no blood present in the stool. The patient was advised to return immediately to the hospital.

Physical examination revealed that the patient was a young female with normal development. She appeared to be acutely ill and moaned and complained of pain in the abdomen, more especially in the left upper quadrant. The heart and lungs were negative. Blood pressure was 110/80. The abdomen was flaccid and was not distended. There were no palpable masses and there was no rigidity. Tenderness was present and was most marked over the left upper quadrant. The liver, spleen and kidneys were not palpable.

Laboratory work revealed the following: Hemoglobin, 145 Gm., 93 per cent; color index, .9 plus; erythrocytes per cu. mm., 4.890,000; leukocytes per cu. mm., 14,700; stab cells, 10 per cent; segmented forms, 80 per cent; lymphocytes, 8 per cent; monocytes, 2 per cent. Preoperative diagnosis was mesenteric thrombosis and postoperative diagnosis was the same.

An incision was made to the left of the original wound and all superficial vessels were ligated. Three feet of terminal ileum were excised and a side-to-side anastomosis of the ileum to the ascending colon was performed. The abdomen was closed without drainage and the patient was returned to bed in poor condition.

Gross findings revealed 39 inches of terminal ileum, dark and purple in color. The portion involved extended to a point within 1 inch of the cecum. The bowel was edematous and had lost its luster. The mesentery showed thrombosis of the vessels. The bowel was soft and friable.

Diagnosis: Gangrenous distal ileum.

The patient was given 500 cc. of plasma the night of the operation as had been done during operation. The patient's postoperative course was remarkably smooth and uneventful. There was no distention following surgery and the highest postoperative temperature was 101.6°F. The temperature became normal on the seventh day. On the fifth postoperative day the patient began to have bowel movements. These movements assumed the character of diarrhea and she had six to twelve bowel movements per day. The patient was discharged on the fifteenth postadmission day with the diarrhea still persisting.

The patient continued to have from five to ten bowel movements per day in spite of diet and administration of kaomagma, camphorated tincture of opium, belladonna and similar medication. This condition persisted for eleven months at which time there began a diminution in the fluidity and frequency of the movements. At the end of the sixteenth month the bowel movements were normal in character and in frequency. The patient has been perfectly well since that time and has had a normal pregnancy and delivery four years following thrombosis.

Case 11. Mr. J. H., aged sixty-one, was admitted to hospital, January 29, 1946. The patient complained of pain in the abdomen just below the umbilicus. The patient stated that he had had this pain off and on for the past four or five years. He had been under treatment about four years ago for the same complaint. He stated that recently the pain had been worse. After eating a fairly good-sized meal he said he became nauseated and had to vomit. There was no history of hematemesis. He also stated that his stomach was very "acid." The pain of which he complained

did not radiate but remained in the area of the urinary bladder. He stated that for years he had been troubled with "loose bowels." There had been no recent loss of weight. About four years ago he had the same symptoms and at that time lost about 40 pounds of weight. Stools had been normal; there was no hematuria, nocturia or polyuria. No pain or difficulty upon micturition was present. There was nothing significant in his past history other than an appendectomy forty-seven years ago.

Regional history was negative throughout except for the gastrointestinal history previously reported.

Family history disclosed the following. The patient was married and had three sons and three daughters who were living and well. His father died of "bladder trouble" and his mother was dead of unknown causes. Three brothers and two sisters were living and well. There was no history of tuberculosis, carcinoma, diabetes, hypertension or cardiac disease.

Physical examination revealed that the patient was a well nourished, well developed, white male lying in bed in acute distress. He complained of severe pain suprapubically.

The scalp was clean; there were no exostoses nor discharge or tophi of the ears; ear drums were normal. Examination of the nose was negative. Mucous membranes of the mouth were normal and there were no sores nor ulcers. His teeth were in poor condition with pyorrhea alveolaris present. The pharynx was normal; the tonsils were atrophic and the tongue was moist and protruded in the midline. No abnormalities of the neck were noted. There was no thyroid enlargement; the chest was symmetrical. There was equal expansion of both sides of the chest on inspiration. No abnormalities other than slight emphysema of the chest were found. The lungs were clear to percussion and auscultation; no râles or abnormal sounds were noted. The heart was regular in rhythm and the sounds were distant. No cardiac thrills or murmurs were noted. The blood pressure was 142/84.

The abdomen was slightly obese. A right McBurney's scar was present with a large postoperative hernia. Liver, kidney and spleen were not palpable. There was some pain on pressure just below the umbilicus and in the midline; it was believed that a mass was present in this area. There was no muscle guard or muscle rigidity.

Except for slight enlargement of the left testicle, the genitalia were negative. On the extremities a small growth, the size and shape of a small thimble, was present on the left thigh. There were no varicosities and no edema or limitation of motion. The skin was negative. Reflexes were physiologic. Rectal examination revealed no masses or fecal impactions. The prostate was firm and slightly enlarged.

Laboratory work revealed the following: Hemoglobin, 14 Gm., 90 per cent; color index, 0.9 plus; red blood cells, 4,790,000; white blood-cells, 11,200; Kahn reaction, negative; stab cells, 11 per cent; segmented cells, 79 per cent; lymphocytes, 10 per cent. Urinalysis: Color, amber; appearance, cloudy; specific gravity, 1.030; reaction, acid; protein, plus; sugar, negative; erythrocytes, occasional; leukocytes, occasional; epithelium, plus; casts, negative; crystals, negative.

The patient entered hospital on January 29, 1946 in acute distress. He apparently had an acute retention of urine. Catheterization recovered only 11 ounces of urine. Morphine sulfate was given the patient for relief of the pain. On January 30, 1946, the patient complained of acute pain in the abdomen which was localized about the umbilicus. Pain was accompanied by nausea and vomiting. Catheterization of the bladder showed no retention. The patient stated that he felt better following catheterization.

On January 30, 1946, the patient appeared to be acutely ill. Pallor was marked and the pulse was weak and thready. Blood pressure was 100/70. The patient was moaning with pain and retching. The abdomen was acutely tender to examination and there was some muscle guard and rigidity present below the umbilicus. In view of the tremendous change for the worse in the patient it was decided to convey him to the operating room for immediate surgery. Five hundred cc. of plasma was given prior to surgery. Preoperative diagnosis was intestinal obstruction, acute; postoperative diagnosis was gangrene of the entire jejunum and a large portion of the ileum due to mesenteric thrombosis caused by mass at root of mesentery.

Gross findings revealed that the entire jejunum and a large portion of the ileum were entirely gangrenous. There was a large amount of foul, putrefactive-smelling, sanguineous fluid

free within the abdominal cavity. There was a large mass at the root of the mesentery with obstruction of the blood supply to the bowel and thrombosis of the mesenteric vessels.

The entire length of the bowel involved was resected, together with its mesentery, down to the root. The resection was extended to include the bowel which appeared grossly viable and healthy. An end-to-end anastomosis was then performed using dulox suture. Five Gm. of sulfathiazole was poured into the abdominal cavity and a drain was inserted. The abdomen was then closed in layers and three figure of eight retention sutures were inserted. Clips were used for the skin.

Pathologic report revealed that the specimen consisted of 12 feet of small intestine beginning with the proximal portion of the jejunum. The entire intestine removed had a thickened wall which was dull, dark, black and soft throughout. A portion of the mesentery removed showed many purplish, firm, dried masses within the vessel walls, being perhaps more marked in the lumen of the veins. There were several irregular purplish masses throughout. In the central portion of the mesentery was an irregular unilocular cyst with a thin, shiny wall which contained brown material which was apparently feces.

Sections of the mesentery showed considerable hemorrhage with slight fibrosis and many thrombi throughout its veins. Sections of the cyst previously described as occurring in the mesentery showed a hyalinized fibrous tissue wall with some round cells and some golden-brown pigment.

Diagnosis: Mesenteric thrombosis with gangrene of the entire jejunum and a portion of the ileum; old, probable inflammatory cystic mass in the mesentery.

The patient returned from surgery in poor condition. Wangensteen suction apparatus was inserted; the patient was given 100,000 units of penicillin and 40,000 every three hours thereafter. The patient's postoperative course was remarkably smooth and uneventful. His highest postoperative temperature was 101.4°F. The temperature became normal on the seventh postoperative day, the clips were removed on the sixth day and the drain was removed on the eighth day. The patient's bowels moved spontaneously on the sixth day and the movements were frequent and resembled diarrhea in character. He was discharged on the eighteenth postoperative day with no complaints other than loss of weight and diarrhea. The high caloric diet and high vitamin diet which the patient had received during his convalescence in the hospital was continued at home.

The frequent bowel movements continued in spite of administration of kaomagma, paregoric, etc., for five months, at which time they diminished in frequency and fluidity. At the present time, which is eight months after surgery, the patient has from three to five movements a day which are soft but not liquid. He has gained 20 pounds in weight and has no complaints other than the complaint of always being hungry.

SUMMARY

1. Prior to this report 116 successfully resected cases of mesenteric thrombosis have been reported in the literature.

2. Of the 116 cases there have been twenty-six patients with a resection of more than 200 cm., the average being 314 cm.

3. The disease is rarely diagnosed preoperatively.

4. The condition is 100 per cent fatal without surgery.

5. Surgery is indicated regardless of the apparent futility of the procedure.

6. Two additional, successfully resected cases are reported by the author; one is of a twenty-seven year old female and the other is of a sixty-one year old male, the amount of bowel resected was, respectively, 99 cm. and 366 cm. The distal portion of the small intestine was involved in the first case and the proximal portion of the small intestine was involved in the second.

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HARVARD MEDICAL SCHOOL
BOSTON

THE Harvard Medical School started as a branch of the University in 1782, when three professorships of medicine were established. The first degrees, Bachelor of Medicine, were conferred in 1788. Until 1811 the degrees of Bachelor of Medicine and Doctor of Medicine were conferred, the former on graduation from the Medical School, the latter on examination at least seven years after graduation. In 1811 the degree of Doctor of Medicine was granted to graduates of that year and to earlier graduates who had not been admitted to it, and all graduates since 1811 have received this degree. From 1911 to 1921, inclusive, the degree of Doctor of Public Health was conferred for graduate work. Since 1921 the degrees of Bachelor of Public Health, Master of Public Health and Doctor of Public Health have been conferred under the School of Public Health.

When the Medical School opened, the first lectures were given in the buildings of the College, Harvard Hall and Holden Chapel. The School moved to Boston in 1810 in order to be close to whatever hospital facilities might develop in a large and growing city, and has remained there since. In 1816 the first Medical School building was erected. From 1882 until 1906 the School occupied the building at the corner of Boylston and Exeter Streets now used by Boston University. In September, 1906, the School moved into its present buildings on Longwood Avenue and Shattuck Street. They are five in number and with their surrounding grounds occupy eleven acres. One of these is designed for administration and four for housing the laboratory departments, and for laboratory and clinical instruction. These buildings are (A) The Administration Building; (B) Departments of Anatomy, Histology and Embryology; (C) Departments of Physiology, Physical Chemistry, Biochemistry and Experimental Surgery; (D) Departments of Bacteriology, Pathology and Preventive Medicine; (E) Houses of Pharmacology, Legal Medicine, Comparative Pathology and Tropical Medicine. The clinical departments are housed in the various hospitals associated with the School. Vanderbilt Hall (F), the dormitory for medical students, is immediately adjacent to the Medical School buildings.

Previous to 1906, the major part of the clinical teaching was carried on in the Massachusetts General and Boston City Hospitals. Since that date, however, there has grown up in the neighborhood of the Medical School, and become affiliated with it, a group of hospitals which are used for clinical teaching and investigation, in addition to the clinical facilities previously at the School's disposal.

Harvard Medical School

New Instrument

A NEW CLAMP DESIGNED TO FACILITATE CLOSURE OF THE DUODENUM IN GASTRIC RESECTION*

RAYMOND W. MCNEALY, M.D. AND JACOB A. GLASSMAN, M.D.
Chicago, Illinois

WHEN it becomes necessary to resect a part or all of the stomach, the duodenum which remains must be closed at its proximal end in a manner that will insure against leakage or disruption. This is not always an easy task. On the contrary, it sometimes develops into a major procedure. When the operation is done for duodenal ulcer, much will depend on whether this ulcer is situated on the anterior free surface of the duodenum or on its posterior pancreatic embedded wall. Ulcers on the anterior wall of the duodenum usually lend themselves to resection in their entirety without great difficulty and with few complications. In these cases the duodenum can be mobilized and freed from its adjacent structures for a distance sufficient to admit of easy closure and inversion of the cut end.

In our group of patients we have found that this new clamp lends itself to a rapid and efficient closure. It is designed to insure easy application under direct vision and while it securely closes the proximal duodenum within the grasp of its jaws, it at the same time permits the distal cut end to slide out of its grasp without being crushed or traumatized. The insertion of a basting stitch serves to prevent the regurgitation or reflux of duodenal contents until the final closure and inversion stitches can be inserted. We are of the opinion that the duodenal stump will be more effectively sealed if the tissues which are sutured and inverted have not been crushed. At present it is the usual custom to apply a crushing type of clamp and then invert the crushed portion of the stump by continuous or interrupted sutures. There is little doubt that healing is accomplished more quickly when the cut ends are inverted without any part of them being devitalized. Devitalized tissue must first be sloughed away before healing can take place. It is in the presence of such devitalized tissue that infection is most likely to originate. If infection does occur, it may lead to local abscess formation or even frank disruption of the duodenal stump.

Probably the greatest number of duodenal stump accidents and complications follow resection for ulcers situated on the posterior wall of the duodenum. These ulcers are frequently located in the first portion of the duodenum and frequently penetrate into the head of the pancreas. If this occurs, edema and inflammatory changes occur in and about this ulcer region, and the walls of the duodenum and the head of the pancreas become edematous, infiltrated and sometimes very friable. In attempting to resect these ulcers serious difficulty may be encountered in finding a line of cleavage between the duodenum and the pancreas. Dissections in the presence of these ulcers and their complications may jeopardize the security of the duodenal closure. The difficulty in determining the line of dissection may lead to accidental

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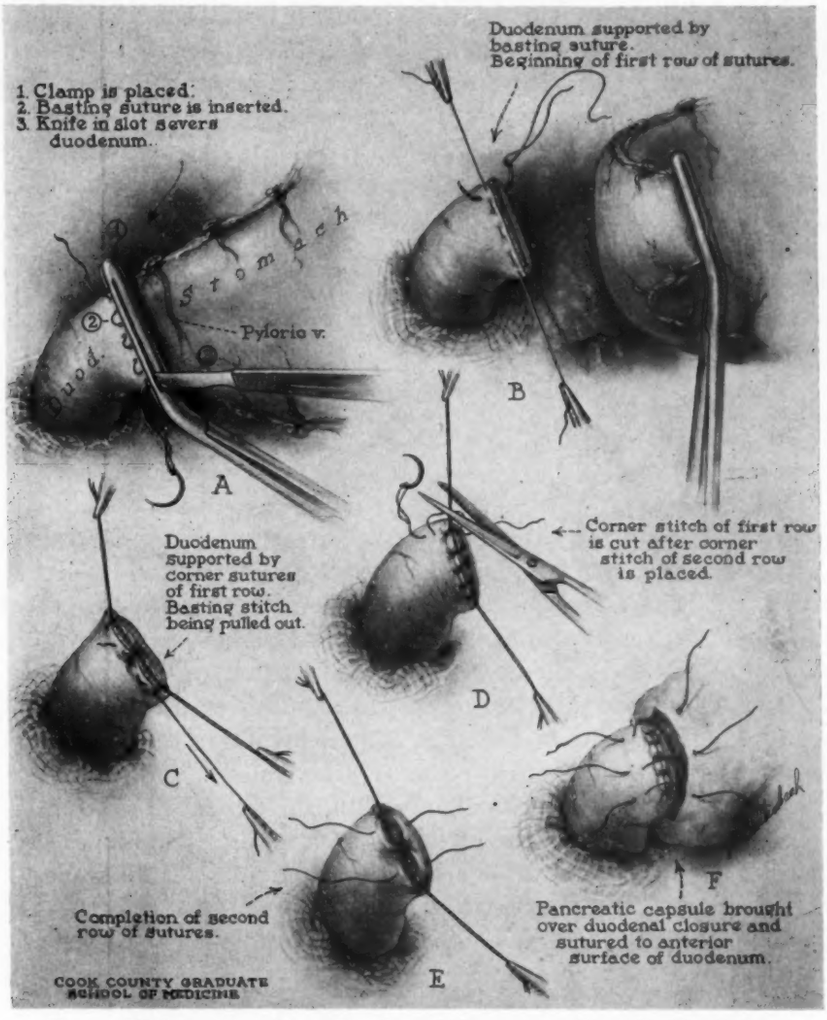

1. Clamp is placed.
2. Basting suture is inserted.
3. Knife in slot severs duodenum.
Stomach
Pyloric v.
Duod.
A
Duodenum supported by basting suture.
Beginning of first row of sutures.
B
Duodenum supported by corner sutures of first row.
Basting stitch being pulled out.
C
Corner stitch of first row is cut after corner stitch of second row is placed.
D
Completion of second row of sutures.
E
Pancreatic capsule brought over duodenal closure and sutured to anterior surface of duodenum.
F
COOK COUNTY GRADUATE SCHOOL OF MEDICINE

Fig. 1. Various steps in application of the non-crushing duodenal clamp.

injury or severence of the gastroduodenal artery or some of its major branches or lead to infringement on the lumen of the common bile duct. It is not within the scope of this paper to discuss the wisdom of excision of all ulcers on the posterior wall of the duodenum. If these posterior ulcers do lend themselves to resection, this new clamp will be found extremely useful. The ease of its application and the facility with which one can resect the duodenum within narrow limits and leave fresh nontraumatized edges to be accurately sutured leaves little to be desired.

Our method of closing the duodenum in resections of the stomach (Fig. 1. A to F) is as follows:

1. After the right gastric artery has been ligated above the convexity of the duodenum and the gastroduodenal artery or its major branches ligated just below the concave border of the first portion the duodenum is then stripped gently from the head of the pancreas until there is sufficient mobility to admit application of this new clamp transversely beyond the pyloric vein.

2. A basting suture is inserted just below the clamp, but as close to its inferior margin as possible. This suture is a temporary one, used only to prevent regurgitation or reflux of duodenal contents until the final interrupted sutures can be inserted for closure and inversion.

3. When the clamp is fixed securely in position, a knife blade is inserted in the slot in the forceps and the duodenum

divided. The proximal half of the blade of the forceps holds the stomach end of the duodenum firmly in its grasp while the distal cut end of the duodenum slips easily out of the forceps' non-crushing portion and is held loosely closed by the basting suture previously mentioned.

4. The clamp and stomach are now reflected to the patient's left.

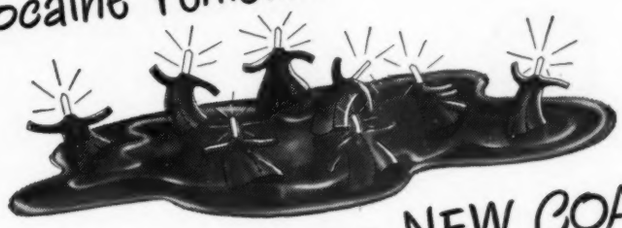
5. The first row of interrupted sutures is now inserted to replace the basting stitch.

6. A second row of interrupted sutures is then inserted to invert and reinforce the first row.

7. As a final safeguard the capsule of the pancreas is drawn over the line of closure and attached by interrupted sutures to the anterior wall of the duodenum thus embedding the sutured end of the duodenum in the head of the pancreas.

W. J. Potts reports a case of congenital atresia involving the transverse colon that survived and may well be the first successful case of its kind. Children born with atresia have the usual symptoms of intestinal obstruction with nausea, vomiting, obstipation, abdominal distention, etc. The site of congenital atresia is almost always distal to the papilla of the Vater, hence bile is present in the vomitus and later, unless relieved by surgery, it becomes fecal. Flat plate of abdomen is most helpful in diagnosis; barium by mouth is unnecessary and is often very dangerous. The usual surgical technic is a short-circuiting anastomosis, joining the sides of the bowel distal and proximal to the site of the atresia in an isoperistaltic manner. Actual resection of the stenosed bowel is unnecessary and prolongs the surgery and shock. These newborns, needless to say, cannot easily withstand prolonged surgical maneuvers. (*Richard A. Leonardo*, M.D.)

Procaine Penicillin



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But here's the punch line! While we were sharing a pot of hospital coffee, that same doctor did ME a favor—by talking about the difficulties of administering multiple 10 cc. doses of unconcentrated serum to infants.

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10 cc. (unconcentrated serum) = 100%
2½ cc. (Hypertussis globulin) = 25%
Dosage volume REDUCED 75%

Lapin (writing in the Journal of Pediatrics) puts the comparison in clinical terms "...administration of a 10 cc. volume (lyophilized residue of 20 cc. of human serum resuspended in 10 cc. of diluent) is painful. Repetition of this 10 cc. dose at frequent intervals becomes a struggle . . . With a ten fold concentration, the immune bodies of 25 cc. hyperimmune pertussis serum can be delivered in 2.5 cc. of the globulin fraction, in an ordinary hypodermic injection."

→With 10-fold concentration in a 2.5 cc. dose Hypertussis* offers "...by far the most rational therapeutic agent yet used in the treatment of whooping cough." (Silverthorne's statement at the A.M.A. Section on Pediatrics, last year)

The point I'm making these days is—When you have a problem in pertussis—rely on 2.5 cc. Hypertussis*, the Cutter specific blood fraction for whooping cough.

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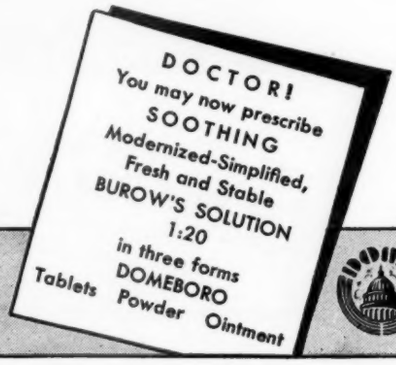

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For correction of the unavoidably lowered nutritional state of the surgery patient, prompt resumption of oral alimentation is called for. Appetite revival becomes a first step to encourage eating and in turn, satisfaction of the increased nutrient requirements. Speed of recovery and wound healing, which are influenced in large degree by good nutrition, give the postoperative diet therapeutic importance.

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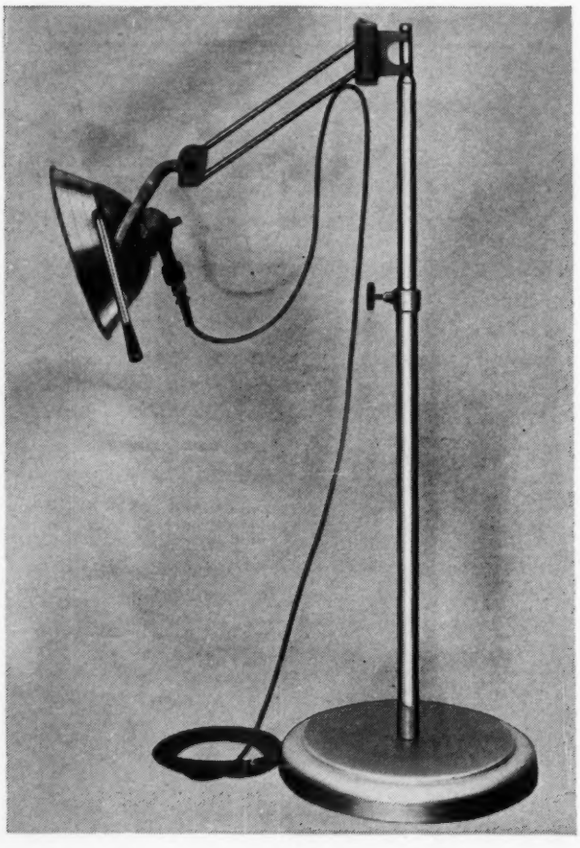
***Based on average reported values for milk.**

Outside the Ivory Tower

(*continued from page* 18)

A NEW explosion-proof light of the type demanded by the National Fire Protection Association will be placed on the market soon by the Wilmot Castle Company. In addition to being explosion-proof the new light has a number of features, such as a counter balanced arm which permits a 25 inch vertical movement of the lamphead, a 24 inch ball bearing swivel rubber thread, special glass filters that prevent any bothersome heat rise in the beam, universal focus and improved shadow reduction. In recent tests RCA engineers called it "The best light used in their television surgical work."



LATEST medical knowledge on the causes and treatment of cerebral palsy is contained in "The Problem of Cerebral Palsy Today," a brand new fifty-seven page booklet written by Dr. Meyer A. Perlstein. Distributed by the National Society for Crippled Children and Adults, Chicago, this booklet organizes and correlates up-to-date information on cerebral palsy and suggests some of the future needs that must be met. Copies of the booklet can be obtained from the National Society for Crippled Children and Adults, Inc., 11 S. La Salle Street, Chicago 3, Illinois, at 25 cents each.

BOYS incur 15 per cent more surgical operations than girls, with 60 per cent of all children's operations being tonsillectomies and 20 per cent appendectomies or fractures, according to an analysis of 100,000 surgical benefit claims of all ages made by a committee of the Actuarial Society of America and presented at the annual meeting of the Society in New York.

THE Northwestern University medical school employed television to bring to the estimated 18,000 physicians and surgeons who attended the American Medical Association meeting in Chicago both surgical procedures and clinical demonstrations. It was the first time in Chicago, and also the first time anywhere on such a large scale, that video has played so major a rôle in medical education. "Television offers a new and promising medium for medical education," said Dr. J. Roscoe Miller, dean of the medical school. "It makes possible intimate instruction in many fields to large numbers of students at one time."

YALE University scientists advanced a theory to account for the mysterious device in the body which tells animals and men when they have had enough to eat or when they are hungry. The theory suggests that the urge to eat is an urge to keep warm. When the thermometer goes up, consumption of food tends to decrease and the body activity slows down; and when it falls, the food intake is increased while an animal or person gets active to keep warm.

DR. CHARLES GORDON HEYD, past president of the American Medical Association, was elected chairman of the board of directors and president of United Medical Service at the association's annual meeting held at headquarters, New York City.

(*continued on page* 38)

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Outside the Ivory Tower

(*continued from page 36*)

THE current issue of the *Stanford Medical Bulletin* honors Dr. Thomas Addis, professor of medicine emeritus, and contains thirty-two articles by fellow workers, associates and students in the field of kidney diseases.

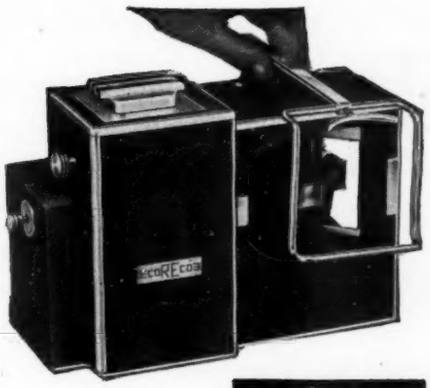
Entitled a "Festschrift for Thomas Addis," the 287 page "celebration issue" of the quarterly medical school scientific publication also includes an appreciation of Dr. Addis by Dr. Ray Lyman Wilbur, chancellor of Stanford University, and by L. J. Poo and William Lew, Chinese research workers who have each been with Dr. Addis as laboratory technicians for more than twenty years. Included among the authors of scientific articles are Franz Volhard of Frankfurt am Main, Germany, and Paul Govaerts of Brussels, Belgium, two of the world's greatest kidney experts, and Dr. F. F. Rundle, an authority on surgery of the heart from St. Bartholomew's Hospital in London.

American scientific contributors represent a roll call of top-ranking U.S. experts in the field of kidney disease and other fields. Among the authors are Drs. Jean Oliver and William Dock, both of the faculty of the Long Island College of Medicine, Brooklyn, N.Y.; Drs. K. F. Meyer and H. M. Evans of the University of California; and Dr. G. E. Burch, of the Tulane University School of Medicine; Dr. Ralph Major, professor of medicine at the University of Kansas; Dr. Linus Pauling, professor of chemistry at California Institute of Technology; Dr. Alfred Snoke, Yale Medical School faculty; Dr. Douglas Drury, University of Southern California and several others. A number of the articles are by Dr. Addis' fellow faculty members at Stanford Medical School, including Drs. Horace Gray, Arthur L. Bloomfield, P. J. Hanzlik, Lowell A. Rantz, Edwin W. Schultz, Charles E. Smith, Harold K. Faber, David A. Rytand, Sidney Raffel, Alvin J. Cox, Jr., Emile Holman and Frank Gerbode.

Dr. Addis, who retired from active teaching when he became emeritus last year, is sixty-six. He was born and educated in Edinburgh, Scotland, and was just starting his academic career at the university there when he was invited in 1911 by Dr. Wilbur, then dean of the Stanford Medical School, to join the Stanford Medical School faculty. Dr. Addis is known throughout the world as an outstanding authority on kidney disorders and with his co-workers has made extensive studies of Bright's disease. Just as rest is the best treatment for a failing heart, so also is it necessary for the treatment of Bright's disease; and to provide this rest for the kidneys, a low protein diet is necessary, the Stanford doctor discovered. Dr. Addis is a former Carnegie Research scholar and fellow and was the first visiting scholar at the Long Island College of Medicine. In 1942 he was awarded the Cullen Prize by the Royal College of Physicians in Edinburgh. The award was for the greatest benefit done to practical medicine in the previous four years. He also has the distinction of being a member of the National Academy of Sciences.

THERE were more than 109,000 patients hospitalized by the Veterans Administration on March 1. If limitations on hospitalization remain unchanged, Veterans Administration predicts a peak load in 1975 of 250,000 patients in its hospitals. Sixty-three per cent more World War II veterans were admitted to Veterans Administration hospitals during 1947 than during the previous year. Admissions of other veterans jumped 32 per cent in 1947 over the 1946 figure. One out of every ten persons in the United States is a veteran of World War II. About two out of every three men between the ages of twenty and thirty-five are World War II veterans. By 1952, veterans and their families will number an estimated 62,300,000, or 43 per cent of the nation's population.

Although a mere 2 per cent of the nation's doctors are qualified psychiatrists, 60 per cent of the Veterans Administration medical load consists of patients requiring psychiatric care. Veterans Administration is training more psychiatrists than all the schools in the country.



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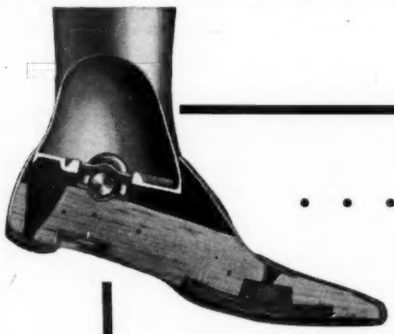

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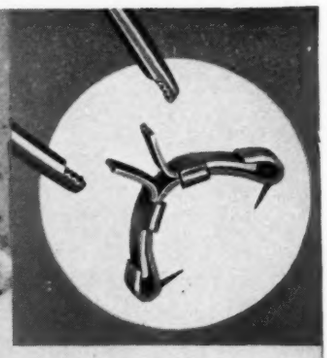

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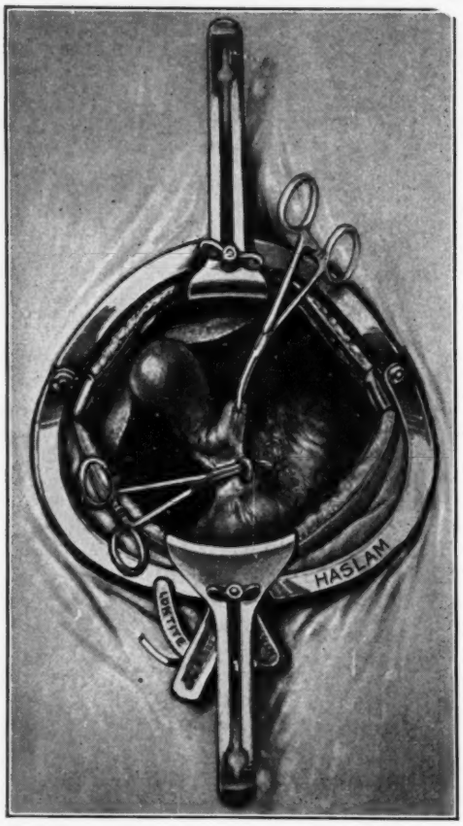

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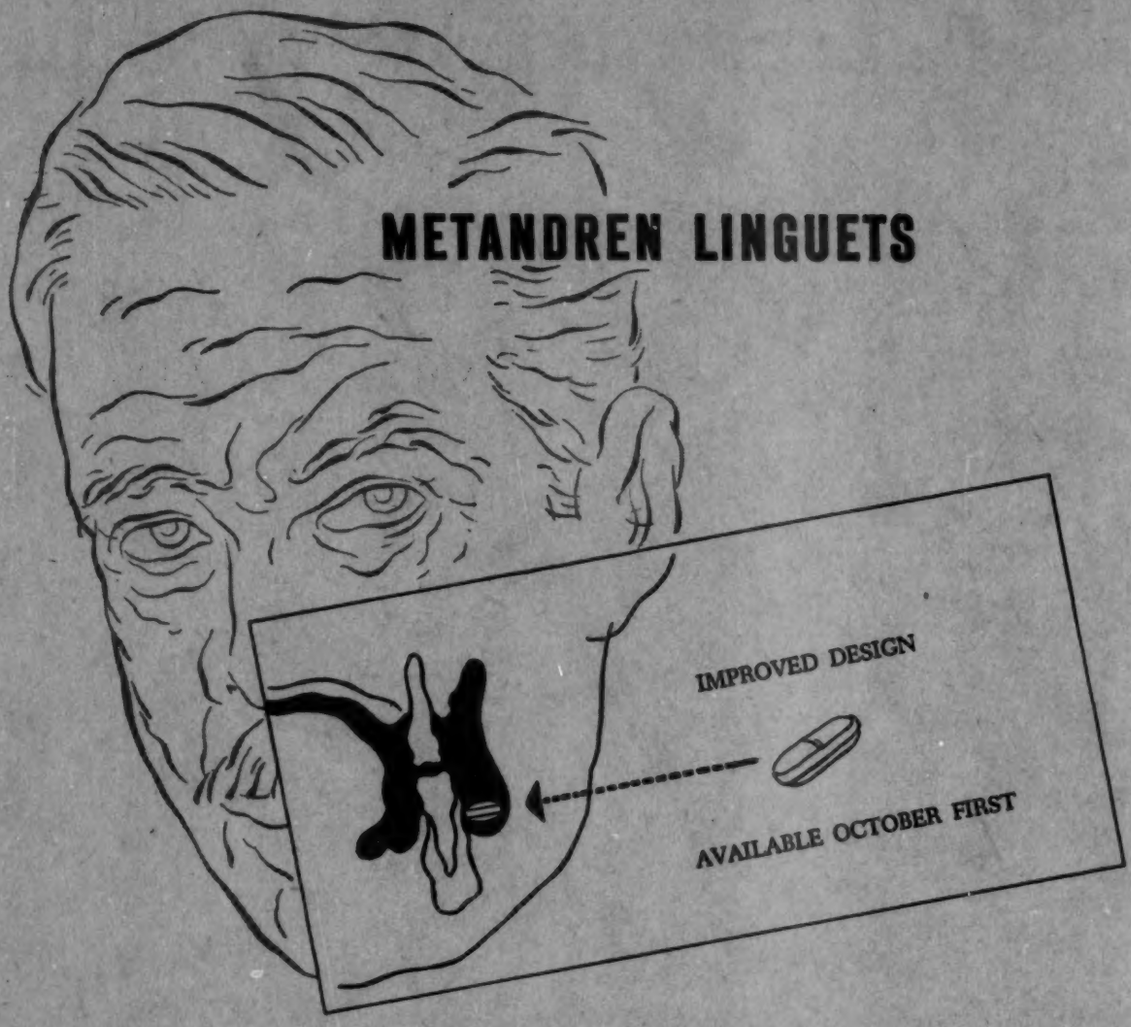

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